THE

JOURNAL

OF

GAS LIGHTING,

WATER SUPPLY,

ETC.

VOL. CIX.

JANUARY TO MARCH, 1910.

LONDON:

WALTER KING,

11, BOLT COURT, FLEET STREET, E.C.

1910.

THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. CIX. No. 2434.] LONDON, JANUARY 4, 1910. [62ND YEAR. PRICE 6d.

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Manufacturers and Contractors. Established 1830.

THE ONLY MAKERS OF
PATENT ANTIMONY PAINT & PARKER'S IMPERIAL BLACK VARNISH,
OXIDE PAINTS, OILS, AND GENERAL STORES, FOR GAS AND WATER WORKS.
GOODMAN SAFETY GAS-MAIN STOPPERS, for Shutting off Gas in Mains temporarily during Alterations and Repairs.
GAS-LEAK INDICATORS, Short's Improved and Ansell Clock Form. *With all Latest Improvements.*
For GROUND USE, FLUSH BOXES, &c. For PURIFIER BLOW-OFF VALVES.

"VITERNUS" PAINT FOR GASHOLDERS.
Makers: JOHN E. WILLIAMS & CO., *Lower Marsh Lane,* MANCHESTER, S.W.

LUX'S Gas Purifying Material
is now used in many Gas-Works throughout Scotland with gratifying success.
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ANY PATTERN MADE INTERCHANGEABLE WITH THE PART NOW IN USE.
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A. G. CLOAKE,
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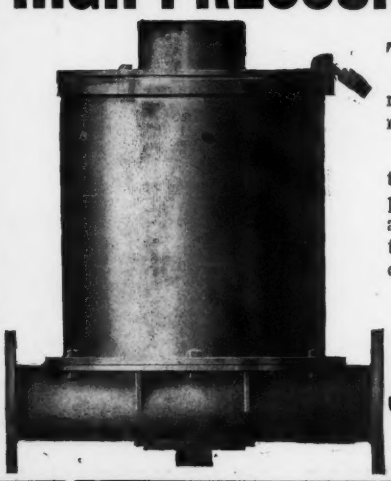
Wet and Dry Gas Meter Manufacturer.
PREPAYMENT METERS for Pennies, Shillings, or any other Coin.
Sole Agent for Scotland: DANIEL MACFIE, 1, North St. Andrew Street, EDINBURGH.

HIGH PRESSURE MERCURIAL GOVERNOR



THIS Governor has been specially designed to work on high pressure mains, where these have been adopted, to effect the necessary reduction from the high pressure in the main to the low pressure required for normal working.

It can be supplied to suit any desired range of pressures; for example, the standard size reduces from 5 lbs. inlet pressure to ordinary low pressure. At the same time the Governor is correctly compensated and so accurately adjusted that, in the event of the main being temporarily used for low pressure distribution, it will work as an ordinary low pressure governor.

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JAMES MILNE & SON, LIMITED,
EDINBURGH. LONDON. GLASGOW. LEEDS.

COCKEY'S PATENT
WASHER SCRUBBER & TAR EXTRACTOR.

August 1st, 1908.

"I am pleased to be able to state that the Scrubber Washer you erected at Harpenden has given every satisfaction. It has Five Chambers, and the Gas is divided into small streams, at each of these Chambers; water flows in at the top and all the Ammonia is eliminated without the aid of any other Plant. . . . The Liquor can be worked up to almost any desired strength. And the Plant has not been cleaned out since you fixed it, and has given us no trouble."

December 2nd, 1908.

"I cannot speak too highly of Cockey's Washers, they are simply invaluable. I gave full Information at the Meeting of an Association of Gas Managers, when President, at Southampton.

If you have plenty of room, I should have an Horizontal one, if short—why then a Vertical one.

The action of the Washer removes every trace of Ammonia."

December 23rd, 1908.

"You asked some time ago as to the working of Tar Extractor. I am pleased to report that it has been working for about six weeks, and is giving great satisfaction.

The whole of the Gas was passed through it for over a month, *without the aid of any other Washing Plant* (whilst the old Plant was being moved) and I was surprised at its being able to cope with the Gas so well, at this time of the year."

December 2nd, 1908.

"In reply to yours of the 1st inst., we have had Two 'Cockey's' Washers erected here, and if another was required, I should certainly put it down in preference to any other make.

It is absolutely certain in action, easy to control, and visible in working. I am sure you could not put down a better Machine. By paying proper attention to the Water supply not a particle of Ammonia passes the last Chamber.

I shall be pleased to answer any further questions on the matter, and if you like to run over and see the Apparatus in work, I shall be pleased to show you our results."

December 2nd, 1908.

"In reply to yours of the 28th ult., just to hand, I may say that the 'Cockey's' Washer was erected for the purpose of removing the last trace of Tar, and dealing with CO_2 and H_2S in the two Bottom Chambers by means of Ammoniacal Liquor, the three Upper Chambers being used for removing NH_3, intending at a later date to erect a supplementary Scrubber. *At the present time the 'Cockey's' Washer is doing the whole of the work*, and we have not found any difficulty in removing the last trace of NH_3. We have passed equal to 300,000 cubic feet per diem.

The only trouble we find in working, is a stopping up of the teeth of the Washing Hoods with Naphthalene, but these are easily cleaned by removing a Hand Cover and applying a stiff Brush. The Overflows work well, and a little attention occasionally is all that is required."

December 2nd, 1908.

"Replying to your Letter of yesterday's date, I have very much pleasure in giving you my opinion of Messrs. E. Cockey and Sons' Vertical Washer, one of which I have here (to pass 500,000 cubic feet per day).

I consider the apparatus a most valuable one, very efficient and does all the work that one can wish, leaving very little Ammonia for the Tower Scrubber to deal with.

Should you desire any further Information, please do not hesitate to ask me for it, and I should be very pleased to show you the Washer at any time you might care to pay me a Visit."

For Prices and all Particulars apply to the Sole Makers—

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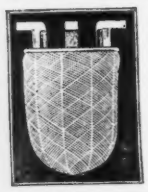

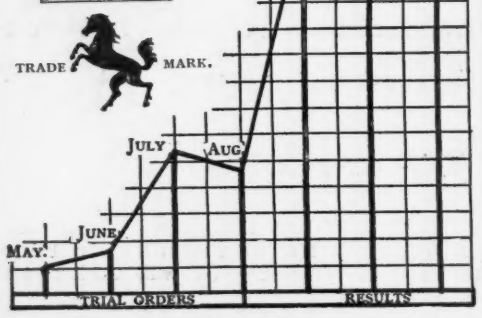

This diagram of monthly Sales shows the success of the "Ross" Patent Mantle since we first brought it to the notice of the British Gas Companies in May last.
The curve speaks for itself.
So does the "Ross" Mantle—Upright or Inverted.

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DUST and INSECT PROOF LAMP
(Intensified).

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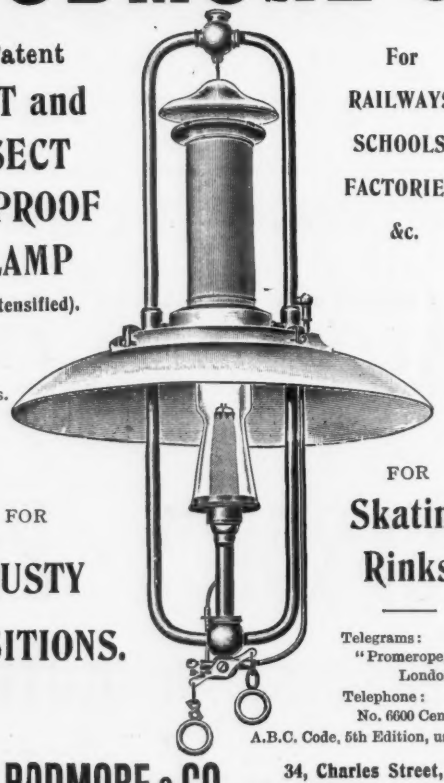

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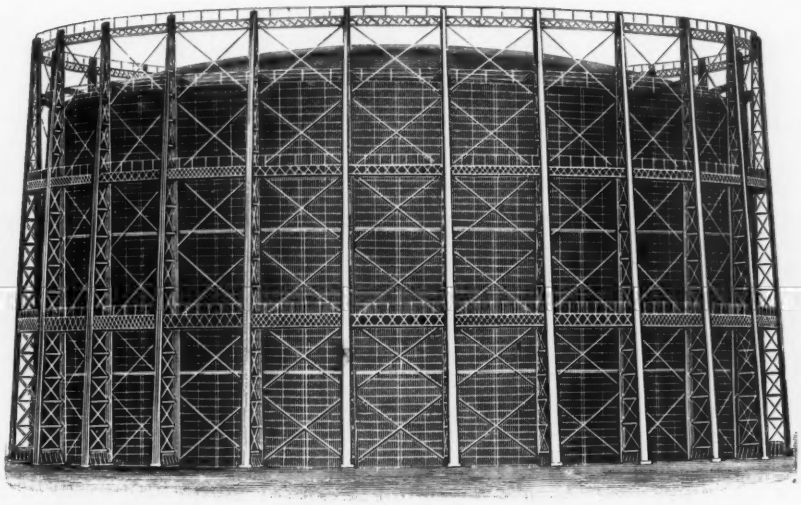

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COLSON'S PATENT CASH-BOX

ENSURES ABSOLUTE SECURITY AGAINST THEFT.

Particulars on Application.

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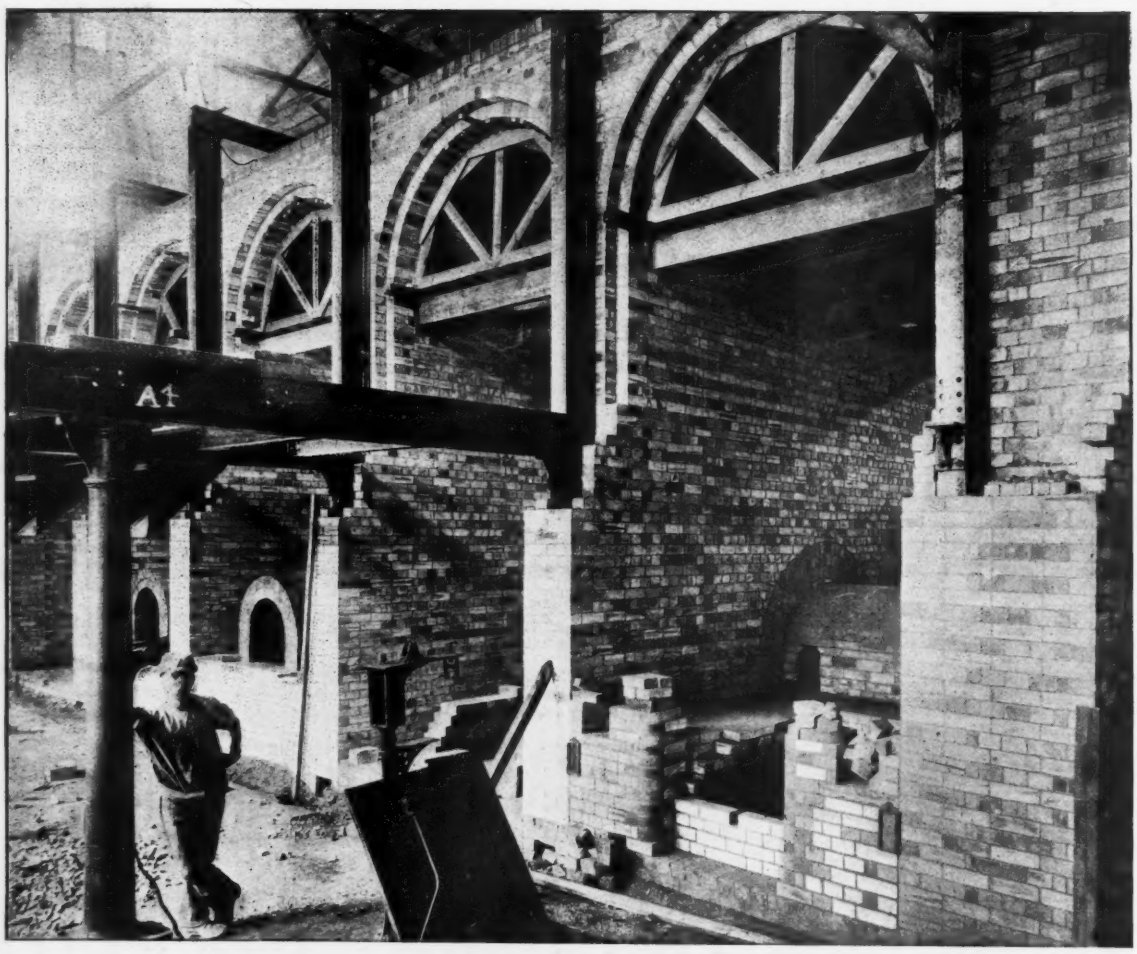

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75-candle power.

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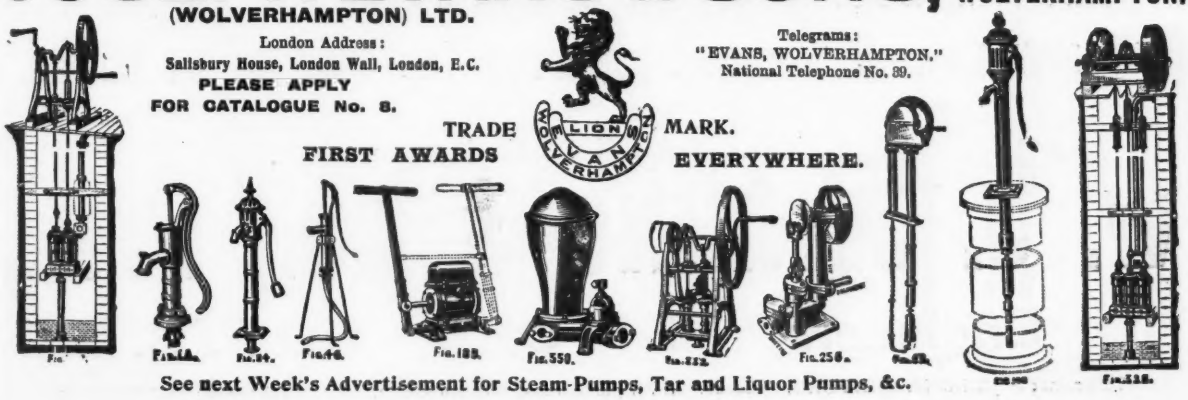

See next Week's Advertisement for Steam-Pumps, Tar and Liquor Pumps, &c.

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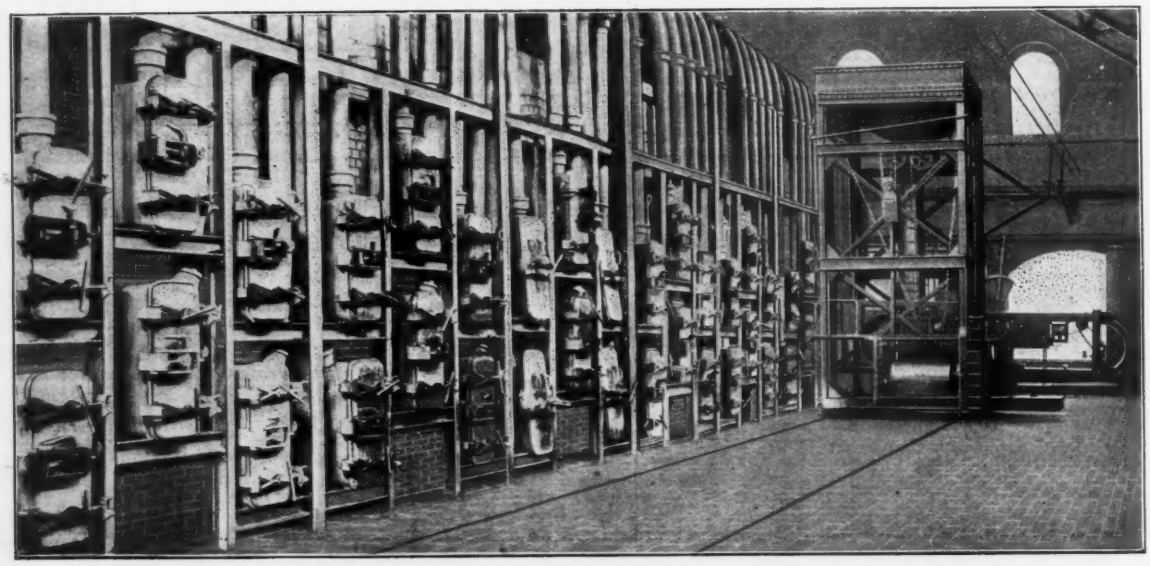
NORWICH CHAMBER RETORT SETTINGS.



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GAS RESULTS, **13,600** cub. ft. of **14·5** c.p. gas per Ton of coal carbonized.

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ADAPTABLE TO EXISTING REGENERATORS.

The work of **CHARGING AND DISCHARGING** these Chamber Retorts is performed by the **"D.B." STOKING MACHINES** with the same **SMOOTHNESS** and **RELIABILITY** that characterizes the working of the **"D.B. MACHINES"** with ordinary Retorts.

THE ONLY MACHINES THAT WILL COMPLETELY FILL CHAMBERS OR RETORTS.

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Make them into **NEW ONES** with the

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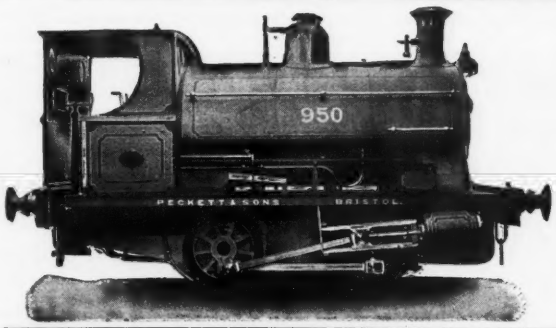

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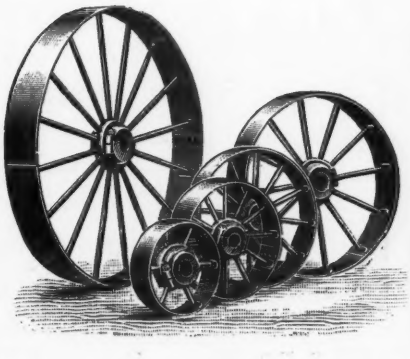

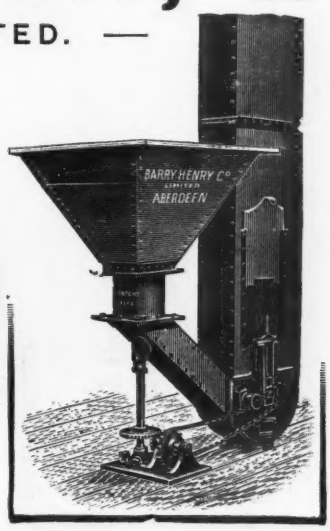

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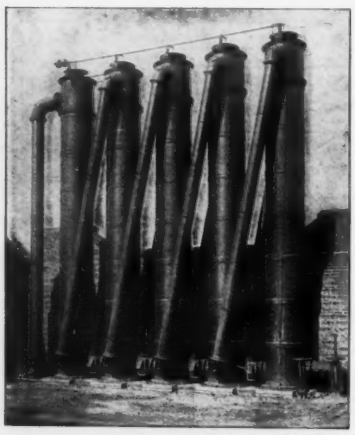

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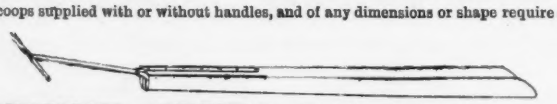

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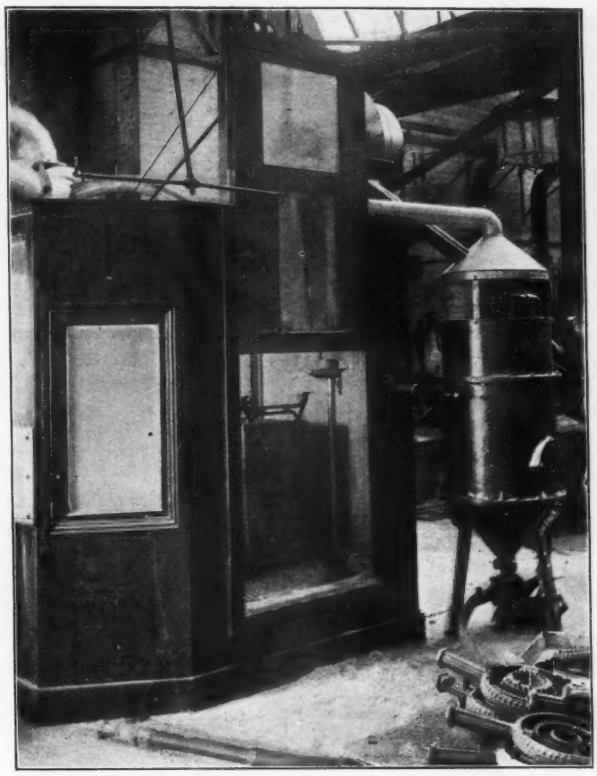

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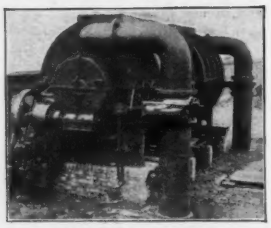
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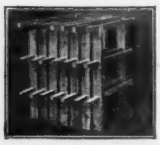
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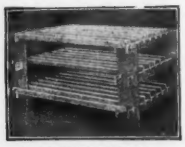
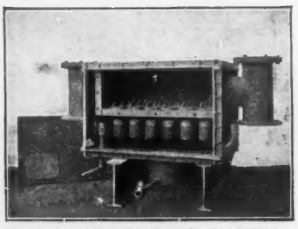

"RACK" GRIDS.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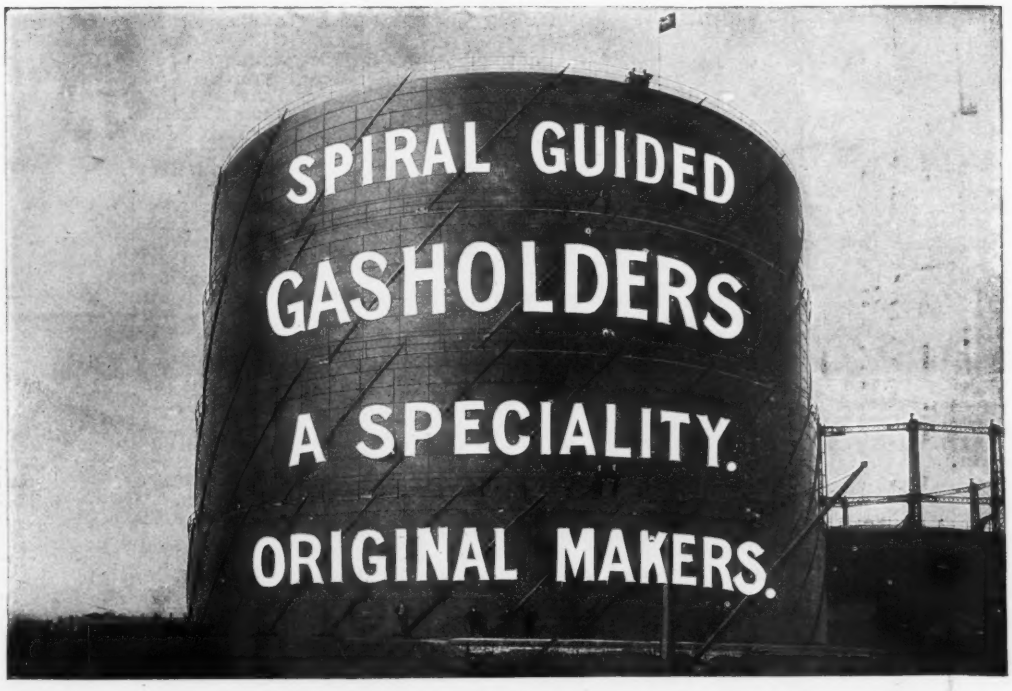

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VOL. CIX., No. 2434.—TUESDAY, JANUARY 4, 1910.

EDITORIAL NOTES—GAS, &c.

Bills under Review—Capital Redemption.

THOUGH Parliament has been prorogued with the view to dissolution in a few days' time, the preparations for Private Bill legislation for the first session of the new Parliament proceed without molestation from the larger political interests now agitating the country. We open to-day our annual review of the Gas Bills as deposited; and though only five of the measures of the new or established limited companies seeking incorporation and parliamentary powers are noticed in the first article, it will be found that they are not without interest. The very first Bill dealt with in virtue of its alphabetical precedence is that of the Bishop's Stortford, Harlow, and Epping Gas and Electricity Company—a new concern, promoted under excellent auspices, and proposing, in one form or another, the fusion of no less than seven Companies. No technical man would question, where a cluster of small concerns is in existence as in this Essex instance, the propriety of, and the economy in, amalgamating the interests, and concentrating management and operations generally. The Bishop's Stortford District Council are forward with an opposing scheme of purchase of the local concern. It appears to us that the Council's proposal is not in the public interest, and that, if they succeed, they will spoil a scheme that holds economical service for the people in a large area, of which Bishop's Stortford only forms part. It will—unless some evidence to the contrary (the existence of which we cannot at present trace) is forthcoming—be a pity if this is the result of their intervention. Should the Company's scheme succeed, the new concern will enter upon its career a fairly substantial one, seeing that the expended capital, with premiums and loan capital, of the seven undertakings, aggregates a few thousands over £100,000; and upon this there will be an immediate prosecution of development work, requiring capital outlay.

Of course with a number of comparatively small companies such as these, the capital stands somewhat higher per million cubic feet of output than a Company should have of the magnitude produced by the consolidation; and moreover concentration means the unavoidable production of a certain amount of obsolete capital. The promoters are therefore asking for the power to form a capital redemption fund, by half-yearly appropriations out of revenue not exceeding ½ per cent. on the capital, including premiums and money borrowed. This is an interesting feature of the Bill; and it reminds of the capital redemption fund of the Gaslight and Coke Company, instituted in their Act of 1903, and continuing operative until a round £1,000,000 of capital has been wiped out by purchase in the open market and cancellation in the stock registers. But in the Bishop's Stortford case now before us, there is provision to the effect that the power is not to operate in respect of any half year immediately succeeding a year "during which the gas sold by the "Company has exceeded the rate of 1 million cubic feet for "each £400 of the paid-up capital," including premiums and outstanding borrowed money. The construction of this provision is not a model of perspicuity; but it simply means that the dividing-line between the operation and inoperation of the proposed redemption fund is £400 per million cubic feet of gas sold.

Among other noticeable features of the Bills under review this week is that three of the five Companies are asking for authorization to supply electricity. Noticeable among the promotions this session, too, are Companies with names that are reminiscent of adverse criticism. But perhaps there is an intention under the palladium of parliamentary powers to put on good behaviour and cast off old domination. It would perhaps be well if in certain Bills a limitation were placed on the dividends. "Unlimited dividends" may be an attraction for prospectuses, but the provision of such attractions by Parliament is not of its functions.

Why the Gas Fire is Superior to the Coal Fire.

IT is our pleasure to publish to-day a novel and valuable report just made in Glasgow conjointly by the Corporation Chemist (Mr. F. W. Harris), the Sanitary Inspector (Mr. Peter Fyfe), and the Chief Engineer to the Gas Department (Mr. Alexander Wilson), as to the relative heating efficiency and contaminating influences of gas and coal fires. The report is opportune just when there is a revival of attention to the subject of atmospheric pollution, and when from many quarters reports are coming in regarding the increasing connections of gas-fires. If the popular mind is to be convinced on the points of gas-fire heating efficiency, cost, healthfulness, and contributory advantage to sanitary atmospheric conditions, in comparison with the coal fire, it must be by means that can be grasped by the lay mind; and herein lies the value of the report before us. We would not have a word eliminated from the document as it stands as a record, nor on account of its technical interest; but it may be suggested that, for later popular use, a digest should be made of the results and conclusions, so that each point may have direct appeal without having to pick it out from the surrounding detail—detail, however, that is essential in the present report to certify the care with which the research was conducted. To the lay mind, the very fact that the comparative tests of the gas fires and coal fires were carried out in two ordinary dwelling-houses identical in dimensions and situation will have weight, as no doubt there exists a popular suspicion that the refinements adopted in scientific investigation, by means of which regulation of various kinds can be effected, are out of harmony with, and inapplicable to, ordinary conditions. There is truth in this. But the technical man knows equally well that, without scientific precision, accurate information cannot be attained that is necessary in the cause of improving progress. Between the Glasgow tests and those made under methods giving scientific control, there are distinctive objects; and this should be borne in mind. The Glasgow tests, being conducted under ordinary conditions of use, are distinguished by novelty and commercial and educative usefulness.

In addition to those parts of the report that are confirmatory of the beliefs and experiences of gas technicians, there are substantial sections that are of technical interest. To make experimental and comparative determinations of the relative heating efficiency, heat losses, and so forth of two distinct and differently constituted methods of heating is a complex matter; and so the Glasgow investigators found, just as Mr. J. H. Brearley and the Department of Fuel and Gas Engineering at the Leeds University have found in their prior experiments on gas-fires. The reporters devote some consideration to the use of the thermopile and galvanometer in making heat determinations; and there is a point in this connection upon which other students may turn their wits in the effort to render assistance in future work. It is that the Glasgow investigators spent, without avail, considerable time in the endeavour to find a suitable method whereby the readings of the galvanometer could be translated directly into heat units. If a method of doing this could be devised, it would considerably facilitate, and add largely to the interest of, investigations of the kind. Though, as a result of the limitation, the efficiency tests are only of comparative value, nevertheless we are not prepared on that account to discount their intrinsic worth. For, in every way, though carried out under ordinary conditions of use, the experiments were surrounded by studied care; and they are therefore of reliable value, under the particular circumstances. In the tests, radiant heat—being, hygienically considered, the ideal mode of heat diffusion—was naturally the basis of the comparative tests of heat efficiency; for, as the investigators remark, radiant efficiency of either gas or coal fires must either commend or condemn each as a suitable source of heat for domestic purposes. The heat diffused from the fires by conduction alone was ignored in the report, as being a relatively negligible quantity. In reference to the

convected heat, the report to the layman would probably impress the idea that heating by convection is altogether undesirable. But this notion, as Mr. John Young, in his recent presidential address to the Eastern Counties Association, emphasized, must not be allowed to be taken as a scientifically accepted truth, as, while radiant heat is the supreme factor, a judicious blending of radiant and convected heat produces the most comfortable conditions.

From the report it is easy, and indeed instructive, to extract the findings of the investigators. In the first place, the great advantage of the coal fire is that the heat imparted therefrom to a room is diffused in the form of radiant heat; but there are rapid and wide fluctuations of the quantity of radiant heat. On the other hand, with gas-fires, the intensity of radiation is rapidly developed, and soon becomes constant. This can be readily appreciated. A coal fire is inconstant in its conditions, and chemical change is perpetually going on, from the one extreme to the other, in connection with it; whereas with the gas-fire the chemical procedure is remarkably constant. This is an advantage on the side of the gas fire. Then the percentage of heat given off in the form of convected heat is rather greater with a gas fire than with a coal fire. The investigators had a repetition of the experience of those who have trodden the same paths formerly in encountering difficulty in accurately ascertaining the percentage of the total heat generated that is lost as flue heat. With such ever-changing conditions as are found in chimneys, due to the prevailing atmospherical conditions, the construction of flues, and the many other circumstances, this is not surprising; nor is it strange that the results of different observers vary so considerably. Even in the case of the gas-fires tested by the Glasgow observers, under conditions precisely similar in regard to dimensions and structure of rooms and chimneys, percentage variations of loss range from 26 to 58. The criticism may, of course, be made that these records have no criterion value excepting under the particular conditions there existing, both permanently and temporarily, at the time the tests were being made. But under these same conditions, the reporters confidently assert that at least 75 per cent. of the total heat generated by the combustion of coal in an ordinary domestic coal fire is lost in the form of flue heat. So far the advantages are on the side of the gas-fire; but when we come to the actual fuel cost, taken independently, the coal fire has an advantage. Using gas at 2s. per 1000 cubic feet, and coal at 10½d. per cwt., in a six hours' trial, the money advantage in favour of coal was 1·385d. But, on the other hand, a better heat efficiency was maintained with the gas fire than with the coal fire; and taking into consideration the numerous collateral advantages of the former (to which unfortunately the public do not give sufficient heed), such as saving of labour, cleanliness, ease of regulation, &c., the difference in bare fuel cost at the prices named is easily wiped out. This trial was a long-hour one; but for intermittent heating, owing to the facility of lighting and extinguishing in the case of a gas-fire, there is no question as to which would then be the more economical, taking even fuel cost alone.

The question of the relative contamination of the inside and the outside air by gas fires and coal fires forms an excellent section of the report. It is a matter upon which, in regard to inside air, there is extant a considerable amount of absurd opinion—traditional from the days when some of the gas-fires placed upon the market could not claim reliability in the matter of complete combustion, and when the crudest ideas were at times found as to how a gas-fire should be fixed. Given an efficient chimney, draught, and a modern gas-fire properly fitted and adjusted, it is, from the hygienic point of view, superior to the coal fire. In this connection, the findings of the Glasgow experimenters are that, using a gas-fire, the proportion of carbon dioxide in the air of a room is incapable of producing any injurious physiological effect; and that the results of experiments to determine the amount of carbon monoxide in the air of the rooms were in every case (with one single exception) entirely negative. In the case of the coal fire experiments, it was ascertained that, under normal conditions of chimney draught, no waste products, either of complete or incomplete combustion, were bye-passed into the room, while the carbon dioxide content of the room was not materially increased. This was due to the rapid change, through the coal fire, of the air of the room, which—to set against the one advantage—produces great loss of heat, and causes draughts. With gas-fires there is not the same rapidity of chimney draught; the change of air of a room being 10 times an hour in the case of the coal fire, as against an average of 5·2 times in the case of the gas-fire. And the ventilation produced by the gas-fire is quite sufficient. The point has application to the conditions of the atmosphere in the case of electrically heated rooms; but this is a matter that does not fall within the scope of the report. The investigators also treat of the relative pollution of the outer atmosphere by gas-fires and coal fires; and what they have to say forms a strong appeal to those who are—and who are not?—concerned in the question of atmospheric sanitation.

We have here a report fully charged with practical suggestion and usefulness; setting out, as it does clearly, the reasons why gas-fires are superior, from the user's point of view, to the wasteful coal fire. Our friends in Glasgow are heartily thanked for allowing the benefit of the results of their labours to be sent, for the common good, broadcast through the gas industry.

Calorific Power in America.

American gas undertakings have not hitherto given much consideration to the question of the calorific power of the gas they supply, and consequently the practice of calorimetry has not been by any means general. But there are rather material signs now that the question is going to grow rapidly in importance for our friends in America. Caution, however, must be exercised by the Gas Companies that the matter is not advanced by too rapid strides; and that it is viewed not only in relation to its immediate phases, but in full perspective, so that, whatever is done, the future of gas supply will not be trammelled by it. The subject is brought prominently to the front by a highly informative report that has been prepared by Mr. Henry C. Hazzard, the Chief of the Division of Light, Heat, and Power of the State of New York Public Service Commission (Second District), as a preliminary to a conference with the Gas Companies on the subject of the need for a calorific standard and on questions incidental thereto. If there is to be a qualitative standard attached to gas, the need of it being a calorific one is established. But a standard of one nominal degree cannot be of universal application owing to the varied conditions of manufacture; nor must the standards be placed too high so as to prove a disadvantage to technical progress. And above all the report establishes, though the recommendations at the end indicate a view on the part of Mr. Hazzard somewhat contrary, that the illuminating power standard should be entirely superseded, and not have existence alongside a calorific power one. These are points that need to be kept well in mind in the conferences and discussions that are to take place among our American friends, on an early day next month.

The report incorporates the results of a considerable amount of testing work; and these are valuable as an addition to the home published records of calorific power tests on coal gas, carburetted water gas, and mixed gases, and as adding to the knowledge that has already subjugated the belief that had at one time currency here, that there is some definite relationship between the illuminating power and the thermal value of a gas. There is not. We find one omission in the report, and it is that, while mention is made of the fact that the calorific power tests were effected by a Junkers calorimeter, there is no statement as to the burner, standard of light, and photometer used in making the illuminating power tests. The information may be common knowledge in America; but it is not so here. However, assuming that the whole of the candle-power tests were made by like means, and so have a common basis and value, the first thing that strikes one is that, generally speaking, the illuminating power is high, and so is the calorific power. In this fact there lies considerable danger in legislating on the present basis for the future.

Because a gas rich in illuminating constituents has been supplied under old conditions of use, and because this gas represents a high calorific value, there is now no reason why the latter should be maintained at the expense of manufacturing economy. There is no disputing that enrichment up to a higher illuminating power will result in the increase of the calorific value; but if the illuminating power minima and maxima in the tables are studied in conjunction with the corresponding figures for calorific power, it is immediately obvious that there is no *pari passu* advance of the latter with the former. And every candle higher in enrichment that one goes, costs more than the candle preceding. The figures in the report do not in any way offer any sufficient

justification for maintaining a high and unnecessary illuminating power for the purpose to which only 20 per cent. of the gas is applied, in order to obtain a disproportionate advantage in increased calorific power. Other lessons to be drawn from the figures are that it is impossible to calculate the unknown value of the one qualitative property from the known value of the other; and a further point is the demonstration of the constancy of the calorific value of a gas as compared with the inconstancy of the illuminating power. Generally speaking, the variations in the illuminating power of any one gas supply in the tables are wide; while the variations in the calorific value of the same gas are narrow. By this one fact, there is quite sufficient light thrown for anyone to see that the maintenance of a high illuminating power may be a positive technical and economic disadvantage in seeking to distribute the greatest quantity of B.Th.U.'s at the lowest possible cost.

The figures and lessons are so many in the report, that we must leave them with an expression of these few broad conclusions. But Mr. Hazzard's own conclusions are those that immediately concern the supplies of gas in the State of New York; and two of his recommendations in a measure show that Mr. Hazzard rather inclines to the setting up of a dual standard, which we protest would be most unfair, and altogether unnecessary. The estimate in the report, founded on collected data, is that the volume of the distributed gas used for heating, power, and incandescent lighting is quite 80 per cent.; and only the remaining 20 per cent. is of importance for its luminosity direct. Therefore, concludes Mr. Hazzard, "unless and until the amount of gas supplied "used in open-flame burners becomes diminished consider-"ably below its present proportion of the total gas con-"sumed, it is desirable that the existing photometrical "standards be maintained;" and further down "that by "reason of the large class of consumers to whom the value of "gas as a generator of heat is a matter of primal import-"ance, it is desirable that the calorific power of gas be "standardized by the introduction of appropriate tests." These recommendations, as they stand, are not in any way qualified; but among the questions he submits for consideration is this one: "Shall such [calorific power] standard be "enforced supplemental to the illuminating standard now "in use?" The answer on the relative volume figures given above is in the negative. Why, we may ask, is 20 per cent. of the gas still used for luminous purposes? The answer is because of the unnecessary maintenance of a high illuminating power for the gas. It is an encouragement to people to neglect the advantage that scientific improvement holds out for their acceptance; and it protracts the diminution of the already comparatively small volume of gas used for its illuminating power. If, when only 20 per cent. of the gas is employed for its luminosity, it is proposed to continue the illuminating power test, how was it that, when only 20 per cent. of the gas was used for its heating value, a calorific test was not then imposed? It has always hitherto been recognized—and it should continue to be—that the standard and test should follow the major use. If protection is needed, it should be accorded to the consumers of the four-fifths of the volume of gas distributed, and not to the laggards who seem to do all they can to avoid the path of illuminating progress.

Regarded technically, towards the end of his report, Mr. Hazzard remarks: "The utmost care must be exercised that "the standard adopted shall, on the one hand, ensure excel-"lence of service, and, on the other hand, not impose "onerous conditions." The dual test would be, and we say it emphatically, an onerous condition; and unreservedly do we concur in the statement (quoted earlier in the report before us) of the Commission who considered the matter in the interests of Wisconsin, that "to require companies to main-"tain a double standard which shall ensure both a high "heating value and a high candle power, would surround "them with such restrictions that economy in manufacture "might not be attained." For these reasons, and having regard to the future, and to the weight of the calorific power case in comparison with the illuminating power one, there is in this country going to be strong resistance to any parliamentary infliction of a dual test; and there should be the same in America. It is true that the Public Service Commission of the State of New York have not at the moment the power to set up any other standard than for illuminating power and purity; but no doubt there is a short course to an amendment of powers in this respect. Anyway, the fact gives more time for discussion.

Newspaper Deception, and a Doctor's Misplaced Confidence.

A perverse fate seems to hang over the daily press in treating of technical matters. In the most simple affairs where it seems impossible for error to happen, stupid blunders are frequently committed; and editorial dignity declines to stoop to admitting the error and rectifying it. This is not just. A case in point occurred last week in the "Daily Telegraph." Prominence was given to a heading "Fatal Gas-Stove Fumes;" and whoever was responsible for this must have been suffering seriously at the time from want of discrimination. The first fatality recorded under the heading was that of a maid at a doctor's house in Cavendish Place; the cause being carbon monoxide poisoning, through the use in a bedroom, without flue or fireplace, of a patent stove in which charcoal was burned. That case, therefore, had nothing whatever to do with "gas-stove" fumes, but with emanations of a so-called "patent fuel" stove. The second case recorded under the heading was that of a man and woman who were suffocated through the misuse of a gas-fire, without vent for the products of combustion. The attention of the Editor of the "Daily Telegraph" was called, by Mr. George Mead-Robins, of Sutton, Surrey, to the injustice to gas heating by the manner in which the occurrences were reported; but the Editor, so far as we have seen, has totally ignored the protest. In the course of his letter, Mr. Mead-Robins wrote:

I desire, in the interests of the gas industry and the gas-consuming public, to point out that both your press notices are open to criticism. The sad occurrence, consequent upon the use of a patent fuel—used in doubtless an excellently designed stove—cannot be identified with a gas-stove. As to the Belfast tragedy, I apprehend that the Corporation Gas Department will agree that, if an ordinary gas-fire were used in the ordinary way, such a catastrophe could not occur, and that there is no more convenient, hygienic, and economic method of heating than by gas. I feel that your notice is calculated to mislead; and, in the interests of a profession with which I have been associated for thirty years, I venture to ask you to be good enough to note these remarks.

It is, to say the least, unfortunate when a paper of the popular standing of the "Daily Telegraph" gives circulation to statements injurious to an industry such as that of gas supply; and then refuses to afford equal publicity to a correction. Apart from this complaint, the first case, in which the maid was suffocated through the fumes from a charcoal stove used in a closed bedroom, attracts particular attention from the fact that this happened in the house of a doctor. We know only too well the old aversion of some medical men to the use of gas-fires, though ventilated, but which aversion is happily being fast dispersed through better acquaintance. Yet here we have a doctor who admits into his house, without question, a "patent fuel" stove, merely verbally commended by a non-technical person "because it gave off no dangerous fumes or obnoxious smell." The result of the doctor's credence is a tragic one.

The "Safety" of Electric Lighting.

After the opening of the evidence at the inquest on the victims of the fearful fire at Clapham Junction, there appears to be no room for doubt as to the origin of the fire having been due to an electrical cause. The facts are clear; and there is in them the subject-matter for serious technical investigation on the part of the electrical industry. Stripped of all the surrounding evidence not immediately pertinent to the question of the origin of the fire, these facts stand out boldly: In certain of the show windows of Messrs. Arding and Hobbs, there was a special installation of electric lamps for decorative purposes at Christmas time; and the work was carried out by responsible contractors, as near as the conditions would allow, to the rules of the Phœnix Fire Office—the insurance company concerned inspecting and approving of the whole installation. The extra lamps installed were mostly tantalums. All the evidence points to the fire having started in one of the windows, in which there were 70 electric lamps. Two gas-lights had been previously used in this window; but they had been removed, and the gas had been capped off by the firm's own experienced gas-fitter. The window dresser who was in and out of the window every day asserts there had never been the slightest smell of gas there, and that it was intended to restore the gas-lights as soon as the Christmas show had ended. Moreover, during Christmas time, gas was only used in this part of the building on the upper floors. Immediately after the outbreak, all the electric lights went out, and the only light in the lower part was that reflected from above by the still burning gas-lights. There

has been a lot of foolish electrical talk about gas feeding the flames, and so on. It requires a great deal of heat to affect iron gas barrelling; and the gas-lights would simply go on burning until the heat of a fierce fire, or the fall of the structure, caused the gas-pipes to collapse. The assistant who saw the absolute commencement of the conflagration asserts that there was an explosion of one of the electric lamp globes; the explosion being precisely similar to one that occurred in the case of an electric lamp globe at a place at which he formerly worked at Streatham. The window dresser, too, stated that, at a shop at which he had worked at Pimlico, an electric lamp globe exploded in similar manner; and at Streatham he had seen a fur catch fire that was in contact with an electric lamp. In the case of the window in which the fire started at Clapham Junction, there were, it is declared, no inflammable goods within 9 inches of any of the lamps. Another witness asserts that, after the electric lights went out, he saw flashes under one of the reflectors in the costume department. These are the naked facts as to the origin of the fire, as deposed to by those on the spot. Their evidence cannot be shaken by writers who were comfortably seated at the time of the outbreak in the editorial arm-chairs of electrical papers, or by people in some place other than the ill-fated premises.

The Report of the Canal Commission.

The Royal Commission who were appointed early in 1906 to inquire into the canal and inland navigation systems of the United Kingdom, issued their final report last week; and an important document it is—alike to the railway companies and to the general body of traders of the country. The recommendations are such as, if carried out, cannot fail to have striking effect in various directions. That something might with advantage be done to improve, and even add to, existing facilities for inland water carriage, has frequently been pointed out in the past—as has also the fact that the differences in conditions are so great as to render it difficult to take as an example of what should be done here the extensive canal systems which are to be found, for instance, in both France and Germany. The Commissioners, as is usually the case in such inquiries, were not unanimous in their conclusions; and three of them do not sign the majority report at all. These are Mr. J. F. Remnant, M.P., Mr. R. C. H. Davison, Civil Engineer, and Mr. J. C. Inglis, the General Manager of the Great Western Railway Company, each of whom presents a separate report. Mr. Davison states his reasons for thinking that the difference between Continental and British conditions makes the policy of Germany, Belgium, and France inapplicable here; and Mr. Remnant adopts somewhat the same views. Mr. Inglis takes a different stand, and expresses the opinion that it would be an anomaly that the financial assistance of a Government whose predecessors left private enterprise to develop, at such enormous cost, a railway system which was to compete with the old, inadequate, and most unsatisfactory canal system, should now be invoked to enable the canals to work up an artificial State-aided competition with railways to which no State aid whatever has been vouchsafed.

The Proposed Scheme.

Having set forth an indication of the views of these gentlemen, a brief sketch may be given of the scheme of the majority of the Commissioners. The chief proposal is the formation of a central Waterway Board for Great Britain, consisting of three or five paid Commissioners, to whom should be transferred the waterways comprised in four main routes, with all their feeders and branches, the acquisition of which by the State they advise. These four main routes connect the Midlands with the estuaries of the Thames, Mersey, Severn, and Humber. The advantages claimed for this scheme are as follows: "These four routes, with the branches which we have specified, should, in our opinion, under any policy of improvement, be treated as great highways traversing Central England. They should be amalgamated under a single control, and should undergo such improvement as will make them efficient means of transporting a volume of long-distance traffic far larger than that which they at present attract. If these steps be taken, and if the amalgamation under the same control, as well as the improvement of certain shorter waterways which would feed the main routes with traffic, be included in the scheme, many of the great manufacturing and consuming centres of England will be linked with each other and with the great seaports by waterways permitting the cheap transport of minerals and goods not requiring the highest speed. The Midland districts will have cheap access to and from the great estuaries for the import of raw material and the export of certain classes of products; and coal may be brought to London by improved waterways from the coalfields of South Staffordshire, and from those in the counties of Warwick, Nottingham, and Derby. Building materials, also, will be cheaply transported, even from distant points, as well as goods which, for various reasons, are more suitable for transport by water than by rail or by road—such as explosives, acids, and things of great size." No construction of new waterways is recommended. Into the financial side of the question, we have no space to enter; but, of course, this constitutes a serious consideration, inasmuch as the Commissioners estimate the total cost of all the improvements (excluding the cost of acquisition) to amount to £17,500,000, which, however, as the improvements are to be gradual, will be spread over many years. The Commissioners advise that the cost of acquisition, or part of it, shall be borne by the State, and not saddled on the revenue of the waterways. The existing gross income of the canals it is proposed to amalgamate amounts, it may be mentioned, to nearly £570,000. In all there were nineteen Commissioners; and of these sixteen sign the report—twelve without any reservation whatever. Glancing at the names, it seems that the twelve who sign without reservation include gentlemen of practically all shades of political opinion. Proposals are also made in the report to the effect that the administration of the Caledonian and Crinan Canals, now vested in the Caledonian Canal Commissioners, should be transferred to the Waterways Board; and there is, too, discussed the suggestion that a great Ship Canal should be constructed to connect the Forth and the Clyde. It is, of course, not intended that the work of the Waterways Board shall for all time be limited to the particular schemes outlined in the report.

The Position of Nitrate of Soda.

However much the general body of nitrate producers may be in favour of combination, it seems that so far success has not rewarded the efforts to come to some arrangement which have been put forth by those entrusted with the task of bringing about some such machinery for the restriction of production and shipments as that which, after being in operation for eight years, expired by effluxion of time at March 31 last. Some explanation of the difficulty which stands in the way of a renewal of the combination is to be found in the half-yearly nitrate of soda report of Messrs. W. Montgomery and Co.; and it is worth attention, both from a general business point of view and as regards the particular case to which it refers. It appears that for a long time prior to the dissolution of the last combination, several producers felt that the method of arriving at the quota due to each producer was erroneous and unjust. It was well known that many producers had, for combination purposes, returned their productive power at from anything up to as much as 50 per cent. in excess of what it really was; and the consequence of this was that other producers who could complete their quotas were deprived of that which justly belonged to them—namely, a higher quota. In the most recent effort to find a working basis, 95 millions of quintals per annum were claimed; while under the free-hand *régime* about 53 millions is the average of the past few months. It is urged that, if a combination is considered a necessity by producers, it should be possible, from past experience, for those who may be entrusted with the formation of one to ascertain with some degree of correctness the effective productive capacity of each, and, in order to save time and minimize disappointment to those who are slow to yield their visionary rights, at once reject claims which it must be well known are false. This might be feasible enough; but a far simpler plan would be for those producers who desire a combination to supply accurate figures regarding their output capacity. In any case, however, it may be that when comparing the actual recent production with the total productive power claimed, allowance should be made for the fact that existing low prices have rendered it necessary to close down some of the dearer-producing officinas which would be in operation when more remunerative rates were obtainable. From which remark it will be gathered that what has been the producers' loss is the consumers' opportunity. The course of prices during the major portion of the past six months has been consistently in the downward direction. Early in July, the value of arrived cargoes was about 8s. 6¼d. per cwt., cost and

freight; while about the middle of November the lowest figure of 7s. 11d. was touched. Messrs. Montgomery and Co. remark that the world's consumption for the past twelve months, at 1,929,000 tons, against 1,732,000 tons in 1908, is highly satisfactory, showing as it does an increase of 11⅛ per cent., or 196,000 tons. Of this quantity, the European Continent accounts for 1,354,000 tons, against 1,275,000 tons, an increase of 6 per cent. An increase of 7¾ per cent. is also shown by the United Kingdom; the figures being 111,000 tons, against 103,000 tons. The United States took 398,000 tons, against 309,000 tons, or an increase of 29 per cent.; and other countries, 66,000 tons, compared with 45,000 tons, or an increase of 47 per cent. The prospects for the coming season are, it is declared, favourable for a large consumption.

A New Publicity Scheme.

The other week mention was made of the advertising schemes of the London Electric Supply Companies, and how the work had been initiated. The municipal electricity undertakings are now dissatisfied with the limited conditions under which their publicity work is conducted. We have not observed any particular limit to action in this regard—in fact, one thing that has always been striking about municipal electricity supply has been the licence possessed and used by the municipal undertakings. However that may be, the Associated Municipal Electrical Engineers (Greater London) are bringing before the Borough Councils a scheme for the constitution of a Publicity Committee of Municipal Electricity Undertakings and Electric Supply Companies. The idea is to form a Committee consisting of municipal and company officials, whose work will be to prepare, print, and publish (with the aid of competent assistants) productions of common interest, such as leaflets, cards, posters, &c. Some guarantee by the various undertakings—£1000 for the first year—is sought; and a basis of subscription on the amount of the undertakings' revenue is suggested. Effective publication at a relatively small cost to each undertaking is the end aimed at. It is thought that those responsible for the control of electric supply works would do well to learn from their competitors—the gas companies—the advantage of handling their businesses in a more broad-minded and progressive spirit. The last words are suggestive of the conversion of the Associated Municipal Electrical Engineers (Greater London) from the errors of past ways. This was the body who imitated the Chinese slavery cartoons by some vile and highly-coloured pictorial slanders on gas for which they got the applause of certain of our electrical contemporaries. Now that these cartoons have displayed their libellous character at the bill-posting stations of the Metropolis, we may ask whether this sort of thing can be called "effective publicity," or whether it merely excites the derision of the very people whose custom it is desired to capture. Judging from the complaints as to the condition of the domestic electricity business, judging from the hysterical cries for greater business energy in domestic electrification, judging from this new scheme of the Associated Municipals, the slanderous cartoons have not been of any great service to the electrical undertakings of London. If the new publicity scheme goes through, we shall be interested to see how the handling of the electricity business in a "more broad-minded and progressive spirit" will shape. If the organization succeeds in its aim, it is considered that its scope will have to be largely extended; and in all probability, either by expansion or imitation, it will spread its influence throughout the country.

One of those pleasant functions which go to illustrate the cordial feelings of friendship and goodwill existing among the officers of the Gaslight and Coke Company took place last Friday. The occasion was the removal of Mr. P. E. Furniss from the Fulham station, where he has occupied a responsible position in the coke office for several years, to the Company's newly acquired works at West Ham; he having been deputed to assist Mr. W. Stephenson, who is in charge of the clerical staff there. Mr. Edward Mann, the head station clerk, having addressed a few suitable remarks to Mr. Furniss, in the course of which he took the opportunity of expressing his entire satisfaction with the manner in which he had performed his duties while at Fulham, and the general regret felt at the severance of a very pleasant connection, presented him with a handsome case of silver-mounted pipes, which had been subscribed for by the coke office staff and a few others, who, at their urgent request, had been allowed to participate in the movement. Mr. Furniss, in reply, expressed his great gratification at so unexpected and pleasing a token of his colleagues' friendly feeling, which he said he entirely reciprocated, and which he would, in his new sphere of duty, do his utmost to continue to deserve.

ELECTRICITY SUPPLY MEMORANDA.

A Review of the Past Year.

ANOTHER year has ended for the electrical industry with the spirit of aggressiveness strong within its administrative and executive workers. Much time and a large amount of attention have been devoted to the commercial situation during the twelve months; and, at the close, the position of affairs is found to be such that it is stimulating schemes of all sorts for giving to the industry's affairs a better aspect. Exhibitions have been frequent; circularizing, advertising, and canvassing have been rampant; misrepresentation—and we use the word deliberately—has been indulged in, if anything, to greater extent than formerly; but with what result? The net profits of many undertakings have been drifting backwards, albeit the output of electricity in some places has been increasing, owing mainly to an enlarged power-load at a lower price per unit than the lighting units. Electricity suppliers are consequently complaining; but, wisely, they recognize that complaint without action will not mend their fortunes. Electrical plant manufacturers, too, are still bemoaning the stagnation that surrounds them; but they are quite helpless. The electrical plant already supplied and fixed has, generally speaking, become too large for the demand made upon it; so that the cloud is likely to be somewhat steadfast for some time to come. And the scapegoat for all this is the metallic filament lamp, which has proved itself to be no respecter of concerns, but has served all undertakings—company and municipal alike—in carving big slices out of the lighting units. Of course, the accounts of the companies for the last six months, and of the municipal undertakings since March, are not before us yet; but there are rumours that the lighting units will show a substantial falling away. The situation is undoubtedly one of concern for the industry; but at times over it there is an attempt to cast a veil of optimism—a very thin and an easily penetrable one. It is hoped that the new lamps will expand the use of electricity for lighting purposes. But the hope does not get much support; for the new lighting business is generally going along much too slowly to have effect in balancing the losses of lighting units by lighting units. To help matters, the "Daily Mail," the "Mirror," and other papers have published some queer articles, purporting to show the public that, using the new lamps, the price of electric lighting is less than that of gas employed in modern ways. The electrical technical papers, too, have given circulation to similar stories; but there is a persistent refusal to meet challenges, and there is nothing but evasion. All that can be shown are a few accounts that possibly do exhibit a saving since electricity was adopted, as compared with gas used wastefully and in an antiquated way. To contrast the ancient and the modern is a favourite pursuit of many an electrician. And sometimes the gas figures include gas used for heating and cooking. In the comparisons of the year, there have been seen such absurdities as giving credit to incandescent gas-lamps for developing an efficiency of only 5 candles per cubic foot of gas consumed per hour. And that was gravely done in a technical electrical paper! The question of dishonesty has not for some time troubled the electrical conscience; and it has troubled less during the past year. But sight is lost of the fact that, where a few accounts exhibiting a saving over gas through easily explained reasons can be produced, there are numerous accounts to be had showing the value of modern gas lighting in yielding economy over electricity. Where these cost methods are not effective, then recourse is had to the poisonous fumes bogey; and attempts are made with the object of securing business to terrorize householders against gas. The London "Electrical Bulletin," the "Electrical Times," and Chairmen of Electricity Companies have played the game very low in this respect, as has been shown in the "Memoranda" during the year.

However, the end of the effect of the metallic filament lamps has not yet been seen. Lower illuminating power units have been developed already for the higher voltages; and the prices of the lamps—high as they still are—have been tending downwards through competition, in which the Welsbach Company have joined. Under these circumstances, the wasteful carbon filament lamp will receive yet greater displacement. The arc lamp branch of lighting has also found the metallic filament lamp, much smaller though it is, a serious obstacle to progress; and already there has been a substitution of arc lamps by groups of metallic filaments in several places both for street and for shop lighting. And the newer type lamps are not the only obstacles with which the electric arc lamps—flame and otherwise—have to contend. The inverted gas-burner is having a bad effect, particularly the high-pressure forms, which, under the modern high efficiencies, put the flame arc out of court in respect of cost and efficient illumination. So much is this so that a deputation of the City of London Corporation has recommended this form of lamp for main street lighting in the City, with ordinary inverted lamps in the side streets, and central suspension wherever possible. The late Chairman of the Corporation Streets Committee bore testimony to the fact that the best example of street lighting in the City was that found in Fleet Street with Keith high-pressure gas-lamps. These points all show that, in the competition, gas is more than holding its own, and would do so better still were it not for the preferential treatment, in street and public building lighting, meted out to electricity where the purveyors are the local authorities. This is one of the means taken

by local authorities, in all too many instances, to provide a questionable form of compensation for lost lighting units for their electricity undertakings.

There has been, in consequence, a great revival of controversy on the street lighting question; and it has been demonstrated again and again that, from the ratepayers' point of view, the action of municipal owners in this respect is not an economic one. The municipalities will not draw a dividing-line between their duty as administrators and as traders. If they would only fairly do this, there would be fewer differences than have been seen during the year with the Local Government Board over the question of street lighting. The Board form the only protection the ratepayer has against prodigal expenditure; but municipal electricity owners deny the right of the Board to stand between them and the spending of large sums of money on the conversion of street-lamps to gain nothing either in actual annual cost or efficiency. Finchley and Yarmouth were last year prominent cases in point; and while the Councils vaguely assert that they are doing the right thing, they absolutely decline to satisfy the Board as to the grounds on which they have arrived at the conclusion that street electric lighting is cheaper and more efficient than gas lighting. There have been attempts to get the better of the Board by empty bluster; but the Board are not so foolish as to allow themselves to be forced into a compliant spirit in that manner. Among other places, the Local Government Board refused a loan for street lighting at Hastings; the London County Council at Marylebone for the same purpose. But this refusal does not stay the hands of the municipal prodigals—they proceed with the work. If the requisite money for initial outlay cannot be got by way of loan, it is taken out of the general rates. In this connection, the Hastings Gas Company gave the Corporation a little lesson as to the legal rights in this matter, by appealing against the general district rate made by the Council on the ground that it was bad in law, as it included retrospective charges incurred and due more than six months before the rate was made, contrary to the Public Health Act, 1875. The Corporation were advised that the Company were right.

But though there is conversion, at heavy cost, of street incandescent gas-lamps to metallic filaments, there is not necessarily satisfaction among the ratepayers. At Hastings, there has not been; and so vigorous was the protest against the Corporation proceeding with the change, that the editor of one of the local papers had, to save his space, to refer his numerous correspondents to the Town Clerk. There was also complaint of the public electric lighting at Chelmsford. On the other hand, public demonstrations with modern incandescent gas-burners, in comparison with electric lamps, both at Beckenham and at Bradford, gained favour for the former in the eyes of the authorities and the public. What, however, is to be thought of the action of the Electricity Committee of the Plymouth Corporation in opposing a public demonstration of street lighting by the Gas Company? Did it show a sign of strength or of weakness? Still in several places, investigation by local authorities of tenders for both gas and electricity—these were mostly where ownership of the electricity undertaking did not affect the question—showed conclusively that economy was on the side of gas lighting. The preferential treatment produced by ownership not only obtains in the streets, but in respect of the lighting of the public buildings. But a Committee appointed by the Local Government Board to inquire into the subject reported, after careful investigation, that "on the whole it does not seem there is adequate evidence to justify the substitution of electricity for gas in institutions where gas is already used." And although there was so much fuss made by the electricians over a statement by a Committee of the Metropolitan Asylums Board, that, in the establishments under the Board, "a financial saving had *generally* resulted where electricity had been substituted for gas"—this being in comparison with antiquated flat-flame gas-lighting—there has not been much heard of the more recent decision of the Asylums Board to convert the flat-flame lighting at Darenth Asylum to incandescent gas lighting. So much for the former report as to a financial saving being created by the use of electricity—the "saving," of course, depending on the remoteness of the gas conditions from present-day efficiency. While on the subject of municipal ownership, it may be mentioned that there have been disclosures during the year at Local Government inquiries and in other ways, as to financial mismanagement of certain municipal electricity concerns.

A great question has been as to how to recoup the lost consumption due to the substitution of carbon filament lamps by metallic filament ones. The height of ingenuity capable of being reached by some of our electrical contemporaries is found in the suggestion that the heating, cooking, and power branches of the business should be developed with all speed. That is to say, consumption lost at 4d., 5d., or 6d. per unit should be replaced by consumption at 1d., or thereabouts, per unit. A poor exchange, truly! But it is the best expedient they can devise for assisting falling fortunes. The expedient has been brandished about under the grandiloquent title of "Domestic Electrification;" and there has been much humorous writing on the subject in the technical press of the industry. One writer, possessing extraordinary perceptive powers, asserted that "the time when gas-cookers will be less numerous, and even near vanishing-point, is not so far off as some people imagine." Others wrote of the mystic powers of electrical cooking and heating appliances for retaining heat to a far greater extent than gas appliances; and by this means the vast difference in the thermal values of gas and electricity was ironed out, and electricity became the more economical. For water heating, too, there can be no competition (so it is said) of gas with electricity; for, behold! the "Therol" water-heater has come, which after storing electricity for twenty-four hours will give sufficient hot water to rise a few inches in an ordinary domestic bath! But effort finds poor reward in slow connection; and it cannot be expected that, when 6 cubic feet of gas will do as much heating work as a unit of electricity, and without employing complicated and expensive appliances, householders are going to rush for the electrical appliances. And while electricians are talking about these matters, the employees of gas companies and committees are busily connecting up gas fires and cookers. The power business is another source of compensation for lighting units over which advocacy is strong. But the quantity of power required in many towns is of a somewhat infinitesimal character; and where power is required, many manufacturers are finding it cheaper to put in a gas-engine and generating plant of their own. What can be done in this way for lighting is instanced on St. Leonard's Pier. At the meeting of the Incorporated Municipal Electrical Association, more than one speaker asserted that a charge of 1d. per unit was no good for developing the power business; and Alderman Highman, of Accrington, pointed out that, with an isolated plant, he was getting his electricity at 0·34d. per kilowatt hour. Electricity purveyors, it must be confessed, have in the path of their commercial progress a fair amount of very awkward impediment. While speaking of power, the great Power Companies have not shown during the year that they are doing much in the way of extricating themselves from commercial failure, and of demonstrating the correctness of the principle of plant concentration with extraordinarily extensive distribution cables.

Yet other suggested restoratives for the electric lighting business have been found by the officers of undertakings in tariff reform. The "telephone" system of charging for electricity (it is not a new one, though put forward as such) is an example—being a fixed charge for the maximum possible demand, with a small after-charge per unit of current consumed. Another source of possible revenue has been the small householder. But all schemes put forward to secure this class of consumer end in a repetition of the experience that a lean revenue and a fat capital expenditure do not make a profitable consumer. Electricity slot meters have not been heard of much during the year; so that it may be taken that they are not rendering much aid—at any rate that is the experience within the field of our own observation. There are meters that do not go well with the restricted use of current by metallic filaments, as would generally be found in the small household; and, on account of this and expense, the old project of charging so much per point of lighting has been set on foot again—only to be knocked down once more when experiment has confirmed already recorded experience, that such schemes do not pay, even taking the average result. At this particular period, when the electricity industry is looking out for as many strings as possible for its bow, the excision of the wiring and fittings clause from the Electric Lighting Acts (Amendment) Bill in the past session is regarded as a serious loss by those who are favourable to municipal trading, and by them it has been held to be another injustice to the industry. Altogether it will be seen the electricity industry has got its work cut out to make a financial success on the present lines of working, unless local conditions are exceptionally favourable.

Opposed to progress have also been the mishaps of the year. People do not like a light that fails; nor do they appreciate the insidious character of electricity in the matter of fire promotion. With regard to the failures of current, and consequently of light, there have been many during the year, involving inconvenience to householders, loss to both shopkeepers and manufacturers, stoppage of theatre and other performances, and danger to the public. The record by us (which is not by any means complete) shows that there was one in January at Landport (Portsmouth); on Jan. 19 at Ashton-under-Lyne; in February, at Camborne; on March 18 at South Shields; on March 26, at Tulse Hill and West Norwood; on April 13, at Belfast; on the Thursday preceding Good Friday, at Hastings, and again on May 6; one evening in June, in the Seafield district of Broughty Ferry; on July 31, at Southend; on Aug. 21, at King's Lynn; on Aug. 29, at Clapham (Yorks); on Sept. 4, at Llandudno; on Sept. 15, at Stepney and Whitechapel; on Sept. 27, in Berlin; two separate failures were reported from Redditch, and one at Barnsley; on Nov. 5, at Oldham; on Nov. 7, in the western part of Brighton; on Nov. 8, at West Ham; on Nov. 22, at Woolwich; and on Dec. 1, there was a partial failure at Birmingham. Farther afield, Winnipeg suffered a complete collapse; and two failures were reported from Sydney. With regard to failures in public places, the Watch Committee of the Corporation of Portsmouth have been impressed with, in the interests of public safety, the importance, owing to the fusing of electric wires and the collapse of the lighting, of having stand-by gas lights in places of public amusement; and they only granted licences to the theatres and to the South Parade Pier on condition that there should be provision made for gas lighting. At the Worthing Baths, too, through the same cause, it was decided that gas-lights should be fixed. Disaffected workmen have found the electric light quite useful on two occasions during the year in pressing claims for fresh advantage. At the Waldorf Theatre, in London, a strike of workmen led to the collapse of the electric light; and the same thing happened at the Hotel Continental in

Paris, through the electricians on the premises abruptly terminating their service to enforce their demands.

In regard to fires and other casualties, the last annual report of the London Fire Brigade and a report relating to the City of London showed that, in proportion to consumers, electrical fires exceeded those caused by gas. On Aug. 18, there was the terrible disaster in the Italian village of Olginate, near Lake Como, which resulted in several deaths and injury to other persons and property; on April 10, there was a fire at a general dealer's shop at South Shields, owing to a defective main; on April 24, a private house at Colchester suffered seriously from a fire caused electrically; in October, a draper's establishment was burnt out at Battersea through, it is believed, the fusion of an electric wire; there was the ghastly, death-yielding and property-destroying occurrence at Clapham Junction just before Christmas (the details are too fresh in memory to need reiteration); the Kyles of Bute Hydro, near Rothesay, was burnt down owing, it is reported, to the fusion of a wire; first reports attributed the destruction of the pavilion on Yarmouth Pier, also just before Christmas, to a fire caused by electricity. This was subsequently denied as the cause, but suspicion lingers. On Dec. 27, Dixon's Boot Factory at Newcastle (damage estimated at £10,000) was burnt down; the cause assigned being the fusion of an electric wire. The Earl of Longford's residence in Bryanston Square was the scene of a fire about the same time through, according to report, "the overheating of an electric lamp." A portable hand lamp was credited with a fire at the Central Garage at Bradford. A fire occurred during the year at the Dundee electricity station. Going from home, the heavy losses involved by electrical fires were shown by an article from America in our issue for Aug. 17 (p. 441); and one from Germany in the issue for Aug. 24 (p. 512).

The questions of defective wiring and the use of flexible wiring were much debated during the year. It was shown by Mr. W. W. Lackie, the Corporation Engineer of Glasgow, that 61 fires in Glasgow, between 1902 and 1908, were due to defective wiring. Mr. S. G. Castle Russell, the Electrical Engineer of the Phœnix Fire Insurance Company, entered a protest against degenerate wiring; and the other day, following the Clapham disaster, in a letter in "The Times" he referred to the danger of running temporary electric wiring and fixing lamps in show windows without taking simple and necessary precautions. He also said: "It does not at all follow that if an electric lamp bulb is broken, the filament is instantly harmless. Experience has proved otherwise; and it is not sufficiently realized that the bulb, after continuous running, becomes very hot. As the electrical adviser to one of the leading fire offices, I have found that the unreasonable practice of placing electric lamps in contact, or in situations where they may come in contact, with combustible material is a *fruitful* source of fires." The "Electrical Review" also remarked in connection with the Clapham fire: "Without offering any opinion as to the origin of the fire, we take this occasion to repeat what we have so often said before—viz., that it is high time that the use of flexible cord in shop windows containing inflammable articles such as every draper's shop contains, to say nothing of celluloid goods, should be absolutely prohibited." The year, as usual, gave a crop of explosions in electric lighting boxes—mostly due to gas generated from the insulating material of the cables. Among the incidents was a serious and destructive affair at Manchester. The Home Office regulations applying to the use of electricity in factories were further discussed during the year; and Mr. G. Scott Ram's annual report on electrical accidents in factories supplied abundant proof as to the necessity for the regulations. Among other occurrences that attracted public attention was the death of a man at the Lot's Road generating-station through an electrical shock at 220 volts. It was noticed that a little paper called "Electricity," purchasable at 1d., had, as an attractive temptation to buy it, a "£15 insurance for death by electric shock!" The year has again shown that what with failures, fires, and fatalities, the advertising literature of the electrical industry requires extensive revision. But it may be expected that the old unscrupulous statements will continue to live, and that electricity will still be lauded by electricians as the safest illuminant on earth.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 59.)

THE feature of the brief and broken week which finished up the year 1909 on the Stock Exchange was its cheerfulness and buoyancy, coupled with a degree of activity much beyond the ordinary. It is perhaps not saying too much to attribute the cheerfulness in considerable measure to the hopeful views regarding the coming elections entertained by the anti-budget majority in the Exchange. The reopening on Tuesday gave good promise, with strong markets pretty well all round; a prominent feature being the improvement in Railways. This continued on Wednesday; and the smoothly concluded settlement of the account was another cheering point. The leading markets were strong and pushful; but in speculative quarters there was some see-sawing. The activity was fairly maintained on Thursday, and the demand for gilt-edged investments was still in full action. Friday was the closing day of the week; and though there was some little realizing, the brightness was maintained till the last. In the Money Market, there was a very large demand for short loans, which put rates up; but discount terms were made easy by quiet business. Business in the Gas Market was pretty moderate considering the season; and the tone was very firm and steady. Several small advances in quotations were scored, and no issue fell back in the opposite direction. In Gaslight and Coke, the ordinary was fractionally stronger—all transactions being within the limits of 103¼ and 103⅜. In the secured issues, there was only one deal; the debenture marking 83¼ *cum div.* South Metropolitan was stronger at from 120 to 121—a rise of 1. In Commercials, the 4 per cent. changed hands at 110 and 110½. Among the Suburban and Provincial group, Alliance old realized 17, British 43, South Suburban rose 1, and Bournemouth ½. In the Continental companies, Imperial was quiet at 175½ and 176⅛, European fully-paid marked 25, and ditto part-paid 18¾—a rise of ¼. Among the undertakings of the remoter world, Bombay was done at from 5⅞ to 6, Monte Video at 12⅞, Primitiva at 7½, ditto preference at 5 3/16 and 5 5/16, ditto debenture at 98, and River Plate at 17⅛.

According to usual custom, we append a table showing the closing prices at the end of 1908 and the end of 1909, with the respective gains and losses in value. These it is impossible to generalize; for in many instances the movements are attributable to special factors. But it may be noted that, while open stocks have advanced, secured issues are less in favour. The Metropolitan and Suburban Companies stand well; and a conspicuous incident is the higher value of Argentine undertakings, in view of economical amalgamation.

GAS COMPANIES.	Prices on Dec. 31, 1908.	Prices on Dec. 31, 1909.	Gain or Loss.
Alliance and Dublin, 10 per cent.	18½—19	17—17½	−1½
Do. 7 per cent.	12¾—13¼	11¾—12¼	−1
Do. 4 per cent. Deb.	100—102	100—102	..
Bombay, Limited	5 13/16—5 15/16	5 13/16—6	+1/16
Do. New, £4 paid	3¼—4⅛	4⅛—4⅛	+⅛
Bournemouth, 10 per cent.	29—30	28½—29	−⅝
Do. B 7 per cent.	16½—17	16 5/16—16 13/16	−3/16
Do. Preference 6 per cent.	15 5/16—16⅛	15 5/16—15 13/16	−⅛
Brentford, Consolidated	246—249	253—256	+7
Do. New	187—190	189—191	+1½
Do. 5 per cent. Preference	122—124	120—122	−2
Do. 4 per cent. Debenture Stock	100—102	99—101	−1
Brighton and Hove, Original	213—216	217—220	+4
Do. A Ordinary Stock	153—156	153—156	..
British	42½—43½	42⅛—43⅛	..
Bromley, A 5 per cent.	114—116	118—120	+4
Do. B 3½ per cent.	84—86	88—90	+4
Do. C 5 per cent.	..	106—108	..
Do. 3½ per cent. Debenture	..	87—89	..
Buenos Ayres (New), Limited	11½—11⅝	14—14⅛	+2⅝
Do. 4 per cent. Debenture	92—94	98—100	+6
Cape Town and District, Limited	4½—5⅛	3—4	−1½
Do. 4½ per cent. Preference	4⅜—5⅛	5 3/16—5 7/16	+¾
Do. 6 per cent. 1st Mort.	47—49	48—49	+1½
Do. 4½ per cent. Deb. Stock	76—78	80—82	+4
Chester 5 per cent. Ordinary	109½—111½	108¼—110¼	−1
Commercial, 4 per cent. Stock	106—108	109—111	+3
Do. 3½ per cent. do.	103—105	103—105	..
Do. 3 per cent. Debenture Stock	81—83	80—82	−1
Continental Union, Limited	93—98	95—97	+1½
Do. 7 per cent. Preference	137—140	137—139	−1½
Derby, Consolidated Stock	123—124	121—124	−1½
Do. Debenture Stock	103—105	103—105	..
East Hull, 5 per cent. Ordinary	98—100	97—99	−1
European, Limited	2 3/16—24¼	21½—25	+¾
Do. £7 10s. paid	17½—18	18¼—19	+1
Gaslight and Coke, 4 per cent. Ordinary	99½—100½	103—104	+3½
Do. 3½ per cent. maximum	89—90	87—89	−1½
Do. 4 per cent. Con. Pref.	106—107	103—105	−2½
Do. 3 per cent. Con. Deb.	84½—85½	81—83	−3
Hastings and St. Leonards, 3½ per cent.	95—97	92—94	−3
Do. 5 per cent.	113—115	117—119	+4
Hongkong and China, Limited	18—18⅛	17⅛—18	−⅛
Ilford, A and C	131—133	144—146	+13
Do. B	103—105	108—110	+5
Do. 4 per cent. Debenture	102—104	100—102	−2
Imperial Continental	179—181	175—177	−4
Do. 3½ per cent. Deb. Red.	95—97	94—96	−1
Lea Bridge Ordinary, 5 per cent.	120—122	119—121	−1
Liverpool United A	226—228	223—225	−3
Do. B	167—168	166—168	−⅛
Do. Deb. Stock	105—107	102—104	−3
Malta and Mediterranean	4⅛—4¼	4⅜—5	+⅝
Metropolitan of Melbourne, 5 p. c. Deb.	100—102	99—102	−⅛
Do. Do. 4½ p. c. Deb.	100—102	100—102	..
Monte Video, Limited	11⅛—12	12½—13	+1
Newcastle and Gateshead, Consolidated	109—110	106—108	−2½
Do. 3½ p. c. Deb. Stk.	91—92	91—93	+⅛
North Middlesex, 10 per cent.	20—20½	..	..
Do. 7 per cent.	13⅛—14	13—13½	−⅛
Oriental, Limited	140—142	137—139	−3
Ottoman, Limited	6¼—6⅝	6¼—6⅝	..
Portsea Island A.	138—140	137—139	−1
Do. B.	132—134	29—31	−3
Do. C	122—124	122—124	..
Do. D and E	104—106	101—103	−3
Primitiva, Ordinary.	5⅜—6	7⅛—7⅜	+1⅜
Do. 5 per cent. Preference.	5⅛—5¼	5⅛—5⅜	+1/16
Do. 4 per cent. Deb. Stock	95—97	97—99	+2
River Plate, Ordinary	13—13⅛	17—17⅛	+4
Do. 4 per cent. Deb. Stock	93—95	98—100	+5
San Paulo, Limited	14—14¼	14½—15	+⅝
Do. 6 per cent. Preference.	..	11⅜—12⅛	..
Do. 5 per cent. Deb. Stock.	50—51	51—52	+1
Sheffield, A.	240—242	233—235	−7
Do. B.	240—242	233—235	−7
Do. C.	240—242	233—235	−7
South African	13¼—13⅜	12¼—12⅜	−1
South Metropolitan, 4 per cent. Ordinary.	120—121	120—122	+½
Do. 3 per cent. Deb. Stk.	85½—86½	82—84	−3
South Shields Consolidated Stock	153—155	160—162	+7
South Suburban, Ordinary 5 per cent. Stk.	118—120	120—122	+2
Do. 5 per cent. Preference Stk.	121—123	120—122	−1
Do. 5 per cent. Debenture Stk.	124—126	122—124	−2
Southampton, Ordinary	107—109	109—111	+2
Tottenham and Edmonton, A 5 per cent.	134—136	133—135	−1
Do. B 3½ per cent.	106—108	111—113	+5
Do. 4 p.c. Deb. Stk.	100—102	98—100	−2
Tuscan, Limited	9⅞—9⅝	9—9⅛	−⅞
Do. 5 per cent. Deb. Red.	100—101	100—102	+⅝
Tynemouth, 5 per cent. maximum	106—108	110—112	+4
Wandsworth and Putney, B 3½ per cent.	128—130	139—141	+11
Do. 3 p. c. Deb. Stk.	72—74	72—74	..
West Ham, 5 per cent. Ordinary.	112—114	..	..
Do. 5 per cent. Preference	124—126	..	..
Do. 4 per cent. Debenture Stock	105—107	..	..

PERSONAL.

Mr. A. Francis last Friday retired from his position of Secretary of the Tavistock Lighting, Coal, and Coke Company, Limited.

Lieut.-Col. Charles Lanyon Owen, J.P., has been elected by the Directors of the Portsea Island Gas Company to the seat on the Board vacant by the death of Alderman Sir John Baker, J.P., M.P., who held the chairmanship for many years. Colonel Owen had for a long time been one of the shareholders' Auditors.

Mr. John Williams, who has been Assistant-Treasurer to the Manchester City Council since 1897, is recommended by the Finance Committee for appointment as City Treasurer, in succession to Mr. Edward Thackray, who has resigned. It is also recommended that Mr. Thackray be appointed Consulting Treasurer.

Alderman F. Geen, J.P., of Stoke, has received handsome recognition of the services rendered by him in connection with the promotion of the Potteries federation scheme, in the shape of a testimonial valued at 400 guineas, subscribed by residents in the district and others. The gifts consisted of two pairs of handsome vases and a magnificent service of silver plate. The presentation was made by the Mayor of Stoke (Mr. W. B. Hackney), who said the talented services which Alderman Geen so freely gave to the district had culminated in the present fair and equitable measure for the federation of the local towns. Alderman Geen had all the way through been the champion of the principles which had been incorporated in the Act as passed by Parliament—always having at heart the interests, not only of Stoke, but of the district at large. He would be lacking in gratitude if he failed to mention that for the admirable services so rendered by Alderman Geen, involving many months of strenuous labour, both by himself and the members of his staff, he had declined to accept the slightest payment. The saving to the pockets of the ratepayers (of whom the subscribers were nearly wholly composed) by this public-spirited action, amounted to many hundreds of pounds. Alderman Geen, in returning thanks for the gifts, admitted that the work he had done had been very hard, and had extended over a long period. What he had done, he said, had been not only for their own town, but for the general well-being of the whole district. As to the federation scheme, in three months they would be having the elections for the new Council; and they knew perfectly well that there would be a great change, not only in Stoke, but in all the towns, as regarded public life. He was one of those who believed that there must be no injury—not in the slightest degree if it could be avoided—inflicted upon any one of the six towns. On the contrary, it must be their united endeavour to cultivate local spirit, because, say what they would and do what they might, it would be impossible to eradicate the public life which had grown up, and which had developed in every one of the six towns. It would be suicidal, it would be contrary to the best interests of the whole district, if one town were to be advanced at the expense of any of the others. He believed that there would be a proper and fair spirit exhibited in the new Council, which would see to it that every district, whether far away from or near to the centre, had the best attention given it, so that it might advance as it had been advancing in past years.

OBITUARY.

The death took place last Sunday week, at his residence at Wrexham, of Mr. John Bury, one of the oldest and best-known residents of the town. The deceased, who was in his 92nd year, had been slightly unwell for a few weeks; but the end came somewhat suddenly, and was due to heart failure. Mr. Bury had been connectod with public life in Wrexham for a great many years. He was the first Clerk to the old Highway Board, the first Secretary of the Wrexham Gas Company, and Auditor of the Wrexham Water Company since its formation; and he was also connected with numerous other concerns.

Mr. James Manwell, the Manager of the Dalmarnock Gas-Works of the Glasgow Corporation, died at his Glasgow residence, on the 22nd ult. Mr. Manwell was 78 years of age. He became Manager at Dalmarnock in 1870, when the works were taken over by the Corporation from the City and Suburban Gas Company. He had not been connected with the gas industry before that, but had been engaged in constructional work at Dalmarnock, and was retained as Manager of the works. For long, the Dalmarnock Gas-Works were the most up-to-date works which the Corporation possessed. It was in them that the experiments were made which resulted in the adoption of the Siemens system of regenerative firing. The new works at Provan were opened in 1904; and in the succeeding April the making of gas was stopped at Dalmarnock. But the works have been all along kept in a fit condition for use in case of emergency—Mr. Manwell continuing to have charge of them. When the works were taken over, they were capable of an annual make of 726 million cubic feet of gas; in the last year in which they were going, the output of gas was nearly 1695 millions. Mr. Manwell devoted his best energies to his duties, and was not in evidence on occasions of public ceremony. He was a capable Manager, trusted by his employers, and looked up to by those who were under him. For some time he had been in indifferent health; but he kept himself in touch with the works down to shortly before his death.

It is with regret that we have to record the death of Mr. Robert Shadbolt, which occurred while he was attending service at the Fleetwood Wesleyan Church on the morning of Sunday, the 19th ult. Mr. Shadbolt, who was for 32 years Engineer and Manager of the Fleetwood Gas-Works, had been in failing health for some time; and it was noticed that when he reached the church he appeared to be in an exhausted condition, having experienced difficulty in making his way against a somewhat heavy snowstorm. The sad event naturally created a painful sensation, not only among the members of the congregation, but among the townspeople, by whom deceased was held in the highest respect and esteem. Mr. Shadbolt was born at Cambridge in 1844, and was thus 65 years of age. He started life at the Cambridge Gas-Works, under his uncle, who was the Manager. Subsequently he had charge of the gas-works at Cambridge, and also undertook similar duties at a gas-works in Shropshire prior to going to Fleetwood. During his sojourn in Fleetwood, Mr. Shadbolt had seen the town develop from its small beginning to its present prosperous state; and with the town's advancement, the gas-works, under his judicious management, made rapid progress also. He was ever ready to assist in any charitable object, and did a considerable amount of good in a quiet, unostentatious manner. Deceased leaves a widow and a grown-up family of three daughters and four sons, with whom the greatest sympathy is felt. Three of the sons are Gas Engineers and Managers. The eldest, Mr. Robert G. Shadbolt, is at Grantham, Mr. Walter Shadbolt at Llandudno, and Mr. Samuel Shadbolt at Kirkby-in-Ashfield. The remains were interred in Fleetwood Cemetery; the coffin being carried by the four oldest workmen in the employ of the Gas Company. One of the Directors of the Company was present, together with a number of the employees; and one of the many floral tributes was from the men at the gas-works.

THE IRON AND STEEL TRADES IN 1909.

The passing of the year 1909 is an event which will be regarded without any very keen feeling of regret by those who are engaged in more than one important industry to which it has brought disappointment. Among the branches of trade in which early hopes have not substantially materialized must be included the iron and steel industries, which have generally speaking experienced anything but a satisfactory time, particularly in the first half of the year. Once again, therefore, there is an inclination to look forward, rather than to reflect upon the events of the past. Just at the present moment, much is being said and written on various subjects; and one of these subjects is trade prospects. The Board of Trade returns relating to imports and exports are being freely quoted in proof of assertions that the outlook is rapidly improving; and in other directions also there are to be noted signs that matters are on the mend. Thus the year starts with promise of better things to come in some branches of industry—and of which promise it is to be hoped we shall twelve months hence have seen the ample fulfilment. Under these circumstances, it seems to be only natural to expect that benefit will accrue to the iron and steel trades; and we turned with interest to the annual review of Messrs. Bolling and Lowe, in order to see whether confirmation of this expectation could be found there. There is, however, not much encouragement contained in it. The firm begin with the remark that depression is the keynote that expresses the prevailing condition of trade over the last eighteen months; and they go on to express the opinion that the law of averages alone gives us the right to expect an improvement, though in some quarters there appears to be a more optimistic tone (which they hardly share) as far as the United Kingdom is concerned. While it is admitted that in the year just closed there were not lacking occasional signs of a break in the clouds, the comment is made that the spasmodic strengthening of prices, though no doubt in many cases a wise business move, was, as an indication of better times, "only a fresh instance of the ostrich burying its head in the sand."

Taking first pig iron, the report states that in the spring a considerable decline took place in the price of Cleveland, which went down to about 46s. 3d.; but later on a gradual increase took place, until the quotation towards the end of December stood at 51s. 3d. —higher than had been the case at any other time during the twelve months. For awhile, it seems, "a few shipments to the United States formed a peg on which to hang the hat of looming prosperity;" but, as a matter of fact, the shipments were quite small. At no time do the United States import any really large quantities—but a very small percentage of their requirements in pig iron being obtained in this way, and that only under exceptional circumstances.

No great variation has been witnessed in the price of rails, as fixed by the English Syndicate; the nominal f.o.b. rates for heavy rails having been £5 10s. to £5 12s. 6d. per ton, with £2 extra for fishplates. It must, however, be added that in many cases there has been considerable difference between the nominal Syndicate prices and the actual rates accepted, which, for heavy rails, have varied from £5 5s. to as low as £5 2s. 6d. per ton, according to special circumstances. In fact, the nominal prices named seem,

it is remarked, in the majority of instances only to have been protective ones, and to have been regulated by the decrees of the International Syndicate as to the quarters in which orders were to be placed. As to the outcry against certain orders going abroad when English works were comparatively idle, there is, say Messrs. Bolling and Lowe, no gainsaying the fact that the orders for rails have not been sufficient to go round; and that while the International Syndicate is in existence, orders have to be apportioned equitably among the members, so that slackness at one or other of the works in the various countries is unavoidable. The truth will generally be admitted of the contention that, if there were work enough for all, there would be no necessity to form a Syndicate for the artificial maintenance of prices. It is gratifying to note the firm's view that in this particular branch of the industry the outlook appears to be improving; and we join in the hope that this anticipation may be realized, and that a larger volume of orders may be diverted to this country. As bearing again on the question of Syndicates, attention may be drawn to the remark that wrought-iron pipes and tubes appear to thrive better under a free market than under the Syndicate (when exports materially declined), as shown by the marked increase in the quantity exported in 1909 compared with 1908.

Copper—always a prime favourite as a medium for speculation—has during the past year received much attention at the hands of the "bulls," which fact, Messrs. Bolling and Lowe point out, provides the explanation of the remarkably steady market conditions in face of the constant deterioration apparent in the statistical position. The highest price (£64 3s. 9d. per ton) was reached in January, and the lowest (£54 10s. per ton) in March. A consolidation of the leading interests in North America has long been impending; but the plans have apparently been disturbed by the declaration that the Standard Oil Company is an illegal Corporation. There is, however, the report says, no doubt that in some form or another the consolidation will take effect; and the idea is that it will thereafter be merely a matter of time and diplomacy for a working arrangement to be made including all the more important producers in the world. Through the greater part of 1909, the tin market was comparatively featureless, though there was during the last few weeks of the year a burst of buying on American account in connection with heavy sales of tinplates made by the United States Steel Corporation for January-June delivery. In February the lowest point was reached—£123 15s. per ton for cash; while the highest figure of all (£153 10s.) was witnessed during December.

Referring to trade in other countries during 1909, the review states that Germany has suffered from the universal stagnation; but in the iron and steel trades the tendency is to centralize every branch in Syndicates, all dovetailing and forming a network which becomes increasingly complicated. As to America, in the early months of the year very pessimistic views of the position were taken. Subsequently, however, a fairly substantial increase in the output of pig iron commenced; and month by month this has advanced, until all previous records seem likely to be outstripped. The fact that large sums of money are announced to be spent in new construction for some time to come, is not indicative of a curtailment of demand. Canada seems, however, to be the only instance of continued prosperity and advancement over the last twelve months; and this wave of prosperity, it is pleasing to learn, appears likely to continue. Manufacturers have made great strides, and constructional work is being pushed forward rapidly; while every encouragement possible is given by the Government in the shape of bounties, legislation, &c.

Messrs. Bolling and Lowe as usual give our exports and their value of pig iron and iron and steel for the eleven months ending Nov. 30 of each of the past three years. They are as follows: Pig iron: Year 1907—1,853,635 tons, value £6,881,870; 1908—1,209,452 tons, value £3,809,616; and 1909—1,052,776 tons, value £3,373,402. Iron and steel: Year 1907—3,138,518 tons, value £37,067,362; 1908—2,694,609 tons, value £31,008,812; and 1909—2,943,846 tons, value £31,853,103. The total exports were: Year 1907—4,992,153 tons, value £43,949,232; 1908—3,904,061 tons, value £34,818,428; and 1909—3,996,622 tons, value £35,226,505.

The concluding sentences of the review may be quoted as they appear: "It is, of course, satisfactory that the exports of iron, steel, &c., for 1909 show an improvement. Before, however, we attach importance to it as a measure of prosperity, the figures of other countries must be taken into account. Again we must express the conviction that the outlook is not bright; but no one will welcome more than ourselves a result in the trading of 1910 that will not bear out our expectations."

It is announced that a Commission has been appointed by some German Gas, Water, and Electricity Companies to investigate and report upon the question of earth currents and their effects. Two experts will go fully into the question of the effects of tramways on the gas and water mains at Brunswick, Cassel, Nuremberg, Beuthen, Düsseldorf, and Warsaw.

According to some statistics given in "The Times," the creations of capital in the past half year were on a much smaller scale than they were in the corresponding period of 1908. In commercial undertakings the falling off was from £11,243,790 to £8,058,980; in gas and water undertakings, from £1,043,975 to £130,000; and in electric light and power concerns, from £800,000 to £500,000.

GAS BILLS FOR 1910.

[First Article.]

Commencing to-day the review of the Bills treating of gas affairs deposited for the next session of Parliament, there are, in the first place, eleven measures to notice in which incorporation is desired and parliamentary powers are asked for.

The first is a Bill of great bulk. This is the promotion of the Bishop's Stortford, Harlow, and Epping Gas and Electricity Company—a concern contemplating the amalgamation of a number of existing interests, and consolidating and extending powers. Briefly the proposal is that the three Companies—Bishop's Stortford, Harlow, and Epping—shall be amalgamated, that in the new Company the undertakings of the Ongar, Newport (Essex), and the Much Hadham Companies shall be vested, and that the undertaking of the Dunmow Company shall be acquired by agreement. Further, that the Company shall be empowered to supply electricity within a certain portion of the limits defined for the supply of gas. It is proposed that the amalgamation shall take place as from on Jan. 1, 1911, and forthwith the Ongar, Newport, and Much Hadham Companies are to be vested in the amalgamated concern. The property and rights that will pass are not to include, in the cases of the Newport and Much Hadham Companies, the cash balances (other than consumers' deposits) and sums standing to the credit of the reserve funds, or coal, coke, and consumable stores, the values of which are to be determined by valuation. The price or consideration for the transfer of the undertaking of the Much Hadham Company is to be £1644. In the case of the other two Companies, the price or consideration is to be the allocation to the present holders of shares or stock in the new Company. The conditions usually applying to such transfers and windings-up are incorporated in the Bill. Provision is made for the taking over and employment of any officers of the three amalgamating Companies or of the Ongar Company as may be required and are willing to enter the service of the new Company. Any officer not taken over, or any officer with a continuous length of service of fourteen years who is not willing to enter into the service of the Company, is to be compensated on agreed terms, or in default of agreement under the decision of an arbitrator. Arrangements are made for the payment of dividends for 1910. Power is next taken for the purchase, on agreed terms, of the Dunmow Company. As to capital, it is proposed that it shall be £240,000, of which £104,568 is the original capital; the remaining £135,432 being additional capital. The division of the original stock into classes, and the allocation of the stock, make a somewhat considerable story. The issue of the additional capital by auction or tender on the conditions that have obtained the last session or two is provided for. On the "A" and "B" stocks the dividend is limited to 5 per cent.; on the "C" stock, and so much of the additional capital as is issued as preference with a dividend of 5 per cent. attaching thereto, also to 5 per cent.; and on the "D" stock, and so much of the additional capital as is issued as preference with a dividend of 4 per cent. attaching, 4 per cent. Reserve, special purposes, and capital redemption funds are provided for. The capital redemption fund may be formed by half-yearly appropriations out of the revenue not exceeding ½ per cent. on the capital, including premiums and all money borrowed or raised on capital account. The fund is to be applied in the purchase and cancellation of stock:

Provided always that all stock so purchased shall be purchased at a price not exceeding the average price of the last six transactions in such stock, or the price at which the last transaction in such stock has taken place . . . or at the current market price, whichever shall be the lowest.

This section shall not operate in respect of any half year immediately succeeding any period of twelve months ending either on Dec. 31 or June 30 (as the case may be), during which the gas sold by the Company has exceeded the rate of 1 million cubic feet for each £400 of the paid-up capital for the time being of the Company (including premiums thereon), and all moneys borrowed or raised on capital account, and at the time outstanding.

The carry-forward at the end of any half year is not to exceed the amount required to pay a year's dividend at the authorized rates. The Company ask for power to borrow (inclusive of the aggregate sum of £14,825 already borrowed by the Companies) one-third part of the issued capital. The first Directors include the names of Mr. H. E. Jones, Mr. F. H. Jones, and Mr. E. L. Burton, and some half-a-dozen others. The lands to be devoted to manufacturing purposes are scheduled. Protective clauses are given in respect of the use of roads, &c., to various authorities. The standard price of gas within a defined "inner area" is to be 4s. per 1000 cubic feet; and the sliding-scale will apply, on half-yearly penny variations in price, on the lines of changes in the dividend by 1s. 9d. upon every £100 of "A" stock, and 1s. 3d. on every £100 of "B" stock. The price in the outer area is not to exceed the price charged in the inner area by more than 1s. per 1000 cubic feet. But "the Company may at any time charge, in any part or parts of the outer area, a price or prices lower than the price or prices charged in any other part or parts of the outer area, but so that such lower price or prices shall not at any time be less than the price charged during the same time within the inner area." But there is a special provision in reference to Ongar. In that area until the price charged by the Company in the inner area is reduced to 3s. 6d. per 1000

cubic feet, the price of gas supplied by the Company within 1½ miles of the existing gas-works of the Ongar Company is not to exceed 3s. 6d. per 1000 cubic feet; but as from the date upon which the price of gas supplied within the inner area has been first so reduced, the provisions of the section will cease to operate. But if owing to an increase in the cost of coal, or other unavoidable circumstances (which the auditors shall certify to be unavoidable), the price charged in the inner area is increased above the price charged in such area immediately before the passing of the Act, the Company are not to be precluded from increasing the price of gas supplied within the 1½ miles of the existing gas-works of the Ongar Company by the same amount per 1000 cubic feet as the price for gas supplied in the inner area is increased. The prepayment meter clauses are varied by the charge for the hire of a meter without fittings not exceeding 15 per cent. per annum on the cost of the meter and the fixing. The standard quality of the gas is placed at 14 candles; and the modern testing conditions are to be applied. All the necessary electricity powers are sought; the area of distribution being Bishop's Stortford, Thorley, Birchanger, Great Hallingbury, Stansted-Mountfitchet, and Elsenham. The Company, however, are not to exercise the powers in Bishop's Stortford without the consent of the Council, unless and until any powers for the supply of electrical energy therein which may have been vested in the Council shall have been revoked or ceased to be in force. Separate accounts are to be kept of the gas and electricity undertakings. An open discounts clause is included for both gas and elecricity, "provided that all discounts or rebates shall be of equal amount under like circumstances to all consumers." In one of the schedules to the Bill, it is seen that the Bishop's Stortford Company have an issued capital of £35,391 (including premiums), and have raised £11,400 perpetual debenture stock. The Harlow Company have issued £21,000 of capital, and have raised £1925 of perpetual debenture stock. The Epping Company have issued £24,198 capital (including premiums). The Ongar Company have issued £6000 of capital, and £1500 loan; the Newport Company have raised £2400 of capital; and the Much Hadham Company have raised £1420 of capital, and £650 loan. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

In the Chipping Norton Gas and Electricity Company's Bill, we have reminder of the proceedings in Parliament on the abortive Mid-Oxfordshire Gas Bill, in a session not very remote from the present. In the preamble of the Bill, it is stated that there is no proper supply of gas or electricity authorized by Parliament in the borough of Chipping Norton and the parishes of Over Norton and Great Rollright. Hence the present proposals. The capital of the old Chipping Norton Company was £7182, divided into 718 shares of £10 each, of which 710 shares were issued—508 being fully paid up, and the remaining 202 shares paid up to the extent of £9 each. Then the preamble informs that the Mid-Oxfordshire Gas Company was incorporated under the Companies Acts with a nominal capital of £50,000, divided into 2500 ordinary shares of £10 each, and 2500 preference shares of £10 each. Out of the £25,000 ordinary capital and £25,000 preference capital, only 182 ordinary shares and 932 preference shares have been subscribed. Notwithstanding the smallness of the subscribed capital, the Company have issued debentures to the total amount of £50,830, the whole of which is charged on the undertaking of the Company, and £4730 is charged specifically on the part of the undertaking which was formerly part of the undertaking of the old Company. It is the Chipping Norton undertaking that the present Company propose to purchase from the Mid-Oxfordshire Company. The Chipping Norton Electric Light and Power Company seem also to have undergone some changes. It was incorporated under the Companies Acts in 1907, with a nominal capital of £2000; and the Company have issued debentures to the amount of £1000. Then the following year the Chipping Norton and District Electric Light Company was incorporated, with a capital of £10,000 in 2000 shares of £5 each. The old Company was wound up, selling their concern to the new Company—the consideration being £500 in cash, and £6500 in either debentures or cash. The new Company issued debentures to the amount of £7000, although the same is not represented by any cash value equalling such amount. It is this undertaking that the Company now seeking parliamentary powers desire to purchase. The limits of supply for gas and electricity are to be Chipping Norton, Over Norton, and Great Rollright. The capital of the Company is to be £12,000, in 2400 shares of £5 each, with one-third borrowing powers. Dividends are not to exceed 10 per cent. on the ordinary capital, and 6 per cent. on the preference capital. Special purposes and reserve funds are provided for. The carry-forward is not to exceed the amount required to pay a year's dividend at the authorized rate. Separate accounts for the two undertakings are to be kept. When the receipts on the revenue account of the electricity undertaking exceed the amount necessary for the ordinary requirements and the payment of 7 per cent. on the aggregate amount of the capital moneys employed in the undertaking, the Company are to make such a rateable reduction in the charge for the supply of electrical energy as in their judgment will reduce the surplus to the maximum rate of profit. The transfers of the undertakings are to take place on the passing of the Act; and the price to be paid for them is to be ascertained by arbitration. The standard price of gas is placed at 4s. per 1000 cubic feet; the sliding-scale applying on the usual terms. The ordinary prepayment clauses are included. The prescribed quality of the gas is to be not less than 14 candles, tested by the "Metropolitan" No. 2 burner. All the requisite electricity powers are included. Other clauses are on ordinary lines. [*Parliamentary Agents: Messrs. Baker and Co.*]

The Farnham Gas Company, Limited, have a capital of 1920 shares of £10 each, entitled to a maximum dividend of 7 per cent. per annum, and 1000 preference shares of £10 each, entitled to a dividend of 5 per cent. per annum. The Company have borrowed on mortgage sums amounting to £6800. The Company desire to be dissolved and reincorporated. Further they ask for the repeal of the Farnham and District Electric Supply Company's Order, the powers of which have not yet been exercised, and for the necessary powers to enable them to supply electricity for public and private purposes within a certain portion of their own limits of gas supply. The capital of the Company is proposed at £60,000, whereof £19,200 (divided into 1920 shares of £10 each) is to be called the original capital, and the sum of £10,000 (divided into 1000 preference shares of £10 each) the preference capital; the remaining £30,800 being the additional capital. The standard dividend on the original capital is to be at the rate of 7 per cent., and on the existing preference capital at the rate of 5 per cent., and similarly on the additional capital issued. The modern auction clauses apply; and reserve and special purposes funds are provided for. Power to borrow is to be taken on the usual line of one-third, inclusive of £6800 already borrowed by the limited Company. The limits of supply are Farnham, the parish of Farnham Rural, and the Frensham ward of the parish of Frensham. The standard price of gas is contemplated at 3s. 9d. per 1000 cubic feet, with the sliding-scale of dividend operating annually on the basis of 3s. 6d. changes for 1d. variations in price. The quality of gas is to be 14 candles, tested in modern manner. The ordinary prepayment meter clauses are inserted. All needful powers are included in respect of electricity; and separate accounts are to be kept. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

The Garnant Gas Company is a new creation; it being considered that it would be to public and local advantage to have a supply of gas in Garnant, Glanamman, Brynamman, Gwaun-cae-gurwen, and Cwmgors, forming parts of the parishes of Llandilo-fawr-Rural, Bettws Llangiwg, and Quarter Bach, in the counties of Carmarthen and Glamorgan. The suggested capital of the Company is £18,000, with one-third borrowing powers. Reserve and special purposes funds are proposed; and the revenue carry-forward is not to be more than sufficient to pay the maximum rate of dividend for one year. The maximum price is put at 5s. per 1000 cubic feet for gas of a prescribed illuminating power of 14 candles, tested under the modern conditions. [*Parliamentary Agents: Messrs. Baker and Co.*]

The Gowerton and District Gas Company is forward with a Bill. It was incorporated under the Companies Acts in 1907, with a nominal capital of £15,000. The capital issued is represented by 272 £5 ordinary shares and 809 7 per cent. preference shares. The Limited Company owe upon debentures £2500, carrying interest at the rate of 5 per cent. Further debentures to the amount of £2000 were issued to certain contractors, but have been surrendered to and cancelled by the Limited Company. The Company also possess only a limited interest in the site of the existing works; and they desire to acquire by compulsion or agreement the gas lands as scheduled. For these reasons it is desired that the Company should be dissolved and reincorporated, with further powers. Turning to the clauses of the Bill, the defined limits of supply are Gowerton and Loughor Borough, and so much of Llandeilo Talybont as is not within the area of supply of the Pontardulais Gas Company, Limited; and also as much of the parishes of Penderry and Cockett as is not within the existing area of supply of the Swansea Gas Company. The capital named is £15,000, divided into 3000 shares of £5 each. "Such number of the shares as is equal to the number of preference shares of the Limited Company held by registered shareholders of that Company immediately before the passing of this Act shall be preference shares entitled to a non-cumulative preference dividend at the rate of 7 per cent. per annum out of the profits of the Company in any year, and the remainder shall be ordinary shares." The customary one-third borrowing power is asked for; and authorization for the compulsory purchase of the gas-works lands is requested. The maximum price of gas is suggested at 4s. 6d. per 1000 cubic feet; to be reduced to 4s. 3d. as from Jan. 1, 1912. The old 10 and 15 per cent. discounts clause has been inserted. The ordinary prepayment meter clause appears. The proposals regarding illuminating power and testing of the gas are on the ordinary lines—14 candles, tested by the "Metropolitan" No. 2 burner. There is an elaborate agreement (appearing as the second schedule to the Bill) made between the Rural District Council of Swansea and the Company, referring to the use of the roads by the latter, and also stipulating that the price of gas shall not at any time exceed 4s. 6d., and after the expiration of two years 4s. 3d., and that the price for public lighting in any part of the district shall in no case be higher than 10 per cent. below the minimum charge to private consumers. The Company are not to oppose any application for electric lighting powers. Provision is also made for the transfer of the undertaking, should the Council or the Parish Councils so desire, on agreed or arbitration terms. [*Parliamentary Agents: Messrs. Baker and Co.*]

Mr. Peter Harris, of Brierley Hill, of the firm of Messrs. Harris and Pearson, of Stourbridge, left estate of the gross value of £25,307. He has bequeathed £500 to his Executors for charitable purposes connected with his native town.

THE HAMBURG GASHOLDER DISASTER.

THE "Journal für Gasbeleuchtung" of the 1st inst. gives some further details, mostly taken from the pages of the "Deutschen Bauzeitung," in regard to the construction of the new gasholder at the Grasbrook works at Hamburg, the tank of which collapsed with such disastrous results on the 7th ult. In so far as these details have not already been given from other sources in the "JOURNAL" of the 14th and 21st ult. (pp. 733 and 805), we reproduce them below.

The restricted ground space available on the works for the erection of a gasholder led to the ordinary form of tank being discarded in favour of a special type. Other considerations which weighed in the same direction were that the site lacked uniformity, and that it was desired to run a railway-line of standard gauge underneath the tank. From the sectional plan of the substructure and the elevation and vertical section of the complete gasholder which are given, it may be seen that the bottom of the annular tank was raised about 6 metres (= 19 ft. 8 in.) above the level of the ground. The ring of masonry forming the outside of the substructure rested on an annular platform, of 63·6 metres (= 208 ft. 8 in.) inner and 77·32 metres (= 253 ft. 8 in.) outer diameter, and having an average thickness of 1 metre (= 39·3 inches). This platform, which was supported by 504 octagonal piles, had thus a width of 6·85 metres (= 22 ft. 6 in.). Special importance was attached to the organic connection of the iron mountings of the piles with the annular platform and with the different pillars or piers, and the arches which joined the latter at the top. There were 32 of these pillars (corresponding with the 32 columns of the guide-framing of the holder) spaced round the annular platform; and they were again connected at the top by an annular platform 4·73 metres (= 15 ft. 6 in.) in width. Below the latter platform arches were built into the openings between the pillars. The openings of the arches were closed by windows and doors, so that the chamber beneath the tank could be used as a store. At the two places where the railway passed through the ring structure, strong platforms reinforced with iron were erected instead of the arches as just described.

The central pillars or stanchions of the floor of the tank were upheld by a hollow circular column, 9 metres (=29 ft. 6 in.) in height, standing on a base-plate or platform 10 metres (32 ft. 10 in.) in diameter supported on 32 piles. The column tapered upwards to a diameter at the top of 8½ metres (= 27 ft. 11 in.), and the hollow space was 4 metres (= 13 ft. 1½ in.) in diameter. This central pillar was connected by five radial beams or bulks of reinforced concrete with the foundation platform of the outer annular structure. Each of these stiffening beams was 1·2 metres (= 3 ft. 11 in.) wide, and 0·75 metre (= 2 ft. 5½ in.) deep, and was supported on three piles.

The bad character of the site, of which the ground had everywhere been previously broken, from the outset caused the driving of the piles to be attended with quite exceptional difficulties. Water had to be applied at times while driving was in progress; and many broken piles had to be replaced by driving others alongside them. The load on each pile was about 60 tons. The masonry ring supporting the tank contained about 8000 cubic metres (= 10,464 cubic yards) of concrete, exclusive of the volume of the piles, or about 19,200 tonnes (= 18,893 tons). The load of ironwork to be carried in addition was—

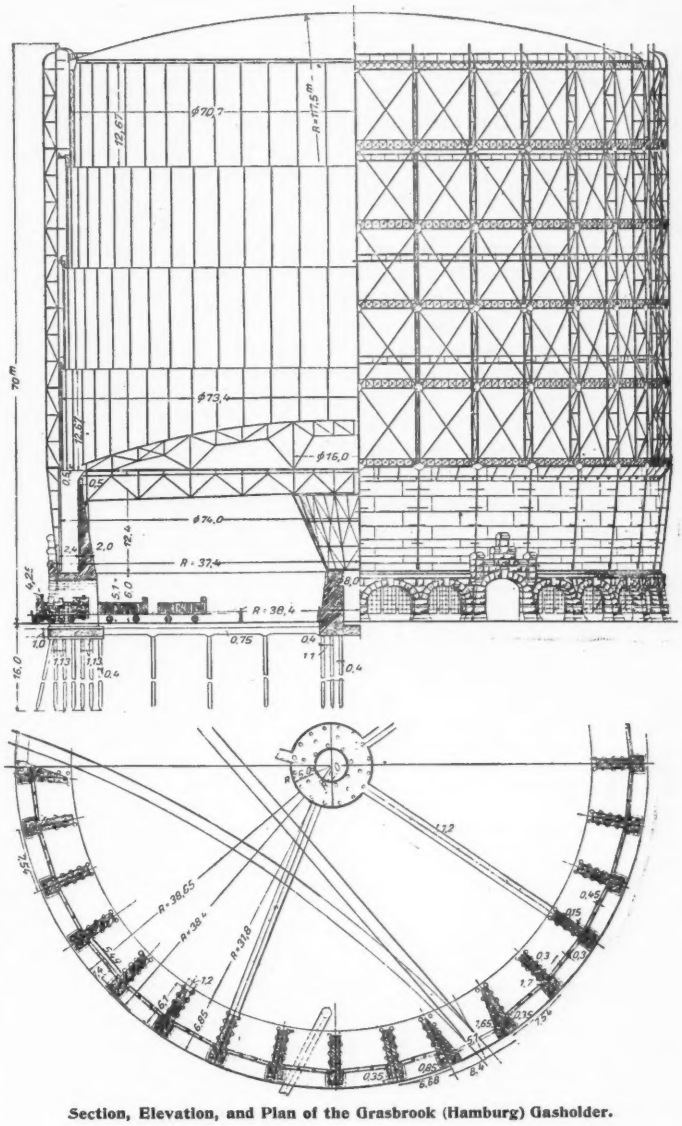
1.—In the annular tank	1254	tonnes	=	1234	tons.
2	,, guide-framing	811	,,	=	798	,,
3	,, stairways . .	23	,,	=	22½	,,
4	,, gasholder bell	1194	,,	=	1175	,,
Total . .	3282	,,	=	3229½	,,

Further the load of water was—

1.—In the annular tank .	6359	tonnes	=	6257	tons
2.—On the floor of the tank	1500	,,	=	1476	,,
3.—In the cups . . .	88	,,	=	86½	,,
Total . .	7947	,,	=	7819½	,,

The total load was therefore 19,200 + 3282 + 7947 = 30,429 tonnes, or about 29,942 tons.

The diameter of the tank was 74 metres (= 242 ft. 9 in.) outside, and 69·2 metres (= 227 feet) inside. Consequently the annular space was 2·4 metres (= 7 ft. 10½ in.) wide. The outer wall was constructed of steel plates, and was 12·9 metres (= 42 ft. 4 in.) high. The inner wall was of cast-iron plates; and the pressure of the water was taken up by a wall of rammed concrete 11·6 metres (= 38 feet) high, and 2 metres (= 6 ft. 6¾ in.) wide at the base, and 0·5 metre (1 ft. 7¾ in.) wide at the top. The flat bottom of the water-tank was covered by water to a depth of about 6 inches. Beneath the tank was a chamber or vault 18 metres (= 59 feet) high, which was roofed by the flat bottom of the tank. It was this part of the structure which gave way from some cause of which the determination is to be the task of a Committee of Inquiry consisting of the most eminent technical men. The water above the bottom ran out so that the gas stored in the holder escaped downwards and ignited. The gas then burnt, as previously described, in enormous tongues of flame issuing from the openings in the annular substructure. It is pointed out, by reference to a reproduction of the photograph given on p. 736 of the "JOURNAL" of the 14th ult. (showing a part of the holder after the fire), that the substructure and annular tank, as well as the guide-framing, remain standing entire; while



Section, Elevation, and Plan of the Grasbrook (Hamburg) Gasholder.

the flat bottom of the middle of the tank and its supporting column are in ruins, and, with the wreck of the roof structure, are piled together chaotically in the vault beneath the holder.

Our German contemporary proceeds to state that conjectures as to the precise cause of the accident at the present time must encroach on the purpose of the Committee of Investigation, and make it more difficult for that Committee to arrive at a proper explanation of the occurrence, while putting very heavy responsibilities on all concerned in the affair. Hence our contemporary intends to reserve its views until the investigation is finished. A full explanation is, it remarks, eminently essential, both to allay the unfounded fears of the public, and to enable technical men to draw a wholesome lesson from the occurrence and to be in a position to avoid the repetition of such a catastrophe.

It is pointed out that, by an unfortunate concatenation of circumstances, the number of victims was far larger than such an accident would ordinarily claim. A great number of men were engaged at the time in painting the holder and in constructional work in its vicinity. The "Journal für Gasbeleuchtung" then proceeds to regret that inquiries made in the proper quarters, immediately the accident became known, for the facts and any explanation met with a rebuff, and that consequently all sorts of conjectures and disquieting rumours were promulgated in the Press. It thinks that the one and best means of preventing

sensational and disturbing reports would have been to have given at once correct information, however brief, as to the occurrence. Gas men would thus at least have had some facts on which to base explanations for which they were called upon everywhere, and would thereby have been able to allay fears. That is the policy pursued in the case of railway accidents. In the interests of the gas industry at large, it wishes to draw the attention of all those in high positions to the desirability, when any accident with gas becomes known to the public, of promptly providing a proper explanation of it so that there shall be no opportunity for others to spread exaggerated and incorrect reports as to the dangers of gas. A hundred years' existence cannot protect the gas industry from such attacks, if proper steps are not taken in the right quarter to at once gain the ear of the public in such a case as that of the Hamburg accident.

STRASBURG GAS WORKS AND SUPPLY.

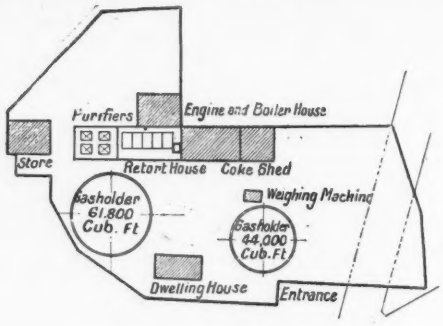
A Record of Fifty Years' Progress.

In the "JOURNAL" for the 23rd of November, we called attention to an interesting *souvenir* of the Jubilee of the Continental Union Gas Company in Strasburg, which had been prepared, with the authority of the Directors, by M. Gaston Kern, the Manager of the works. We are now able to deal at greater length with the contents of the volume, which occupy 300 large quarto pages; but, while recognizing the painstaking research of the author in the compilation of the historical portion of his book, in which he gives an account of the early days of lighting in Strasburg, we must confine ourselves to the record he presents of the progress of the Company and their works during the first fifty years of their operations in the city.

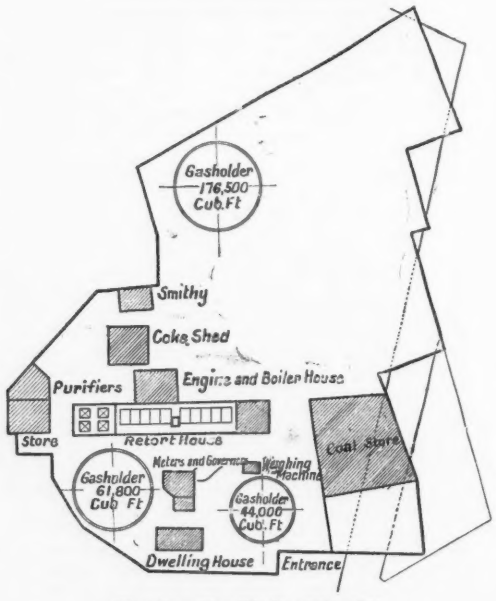
In the twenty years prior to 1858, the gas supply of Strasburg was in the hands of the Union Company of Lyons. When their concession was drawing to a close, steps were taken by the Union des Gaz Company, whose offices were in Paris, to obtain a renewal of it. After considerable negotiation, the Municipal Council ratified, on Oct. 3, 1856, a prolongation of the concession for fifty years from Jan. 1, 1858. The Company were represented by their Managing Directors, Messrs. E. Elsen Goldsmid and W. Brocksopp Gregory, two civil engineers of Paris. At that time, Strasburg had a population of 77,656, inclusive of a garrison of 6000 men. The length of mains was about 13¾ miles, and from them were supplied 454 public lamps. In addition, there were 194 oil-lamps used for lighting the portion of the city in which gas-mains had not been laid. The area to be supplied was clearly defined in the new Treaty. With certain specified exceptions, the mains were not to extend beyond the city gates. In the new Treaty, the Company undertook to replace the old lighting plant belonging to the Municipality, and extend the mains by about 7½ miles; also to supply gas for public lighting at 3s. 4½d. and for private lighting at 6s. 9d. per 1000 cubic feet. The value of the undertaking was estimated at 800,000 frs. (£32,000). The works were placed in the charge of M. Michel Weill-Goetz, who took up his duties on Oct. 1, 1857. Under his able management, both technically and financially, the Company made great progress; so great, indeed, that in 1861 it became necessary to undertake the enlargement of the works, which up to then had occupied an area of about 7200 square yards, to twice their size. Accordingly, land to the extent of 8300 square yards was acquired, and upon it was erected a gasholder having a capacity of 176,500 cubic feet. The progress made by the Company up to the period named is shown by the following figures: In 1858, the total consumption of gas was rather more than 25¾ million cubic feet; whereas in 1861 it was just over 35 millions; the number of public lamps having increased from 496 to 709. In the accompanying illustrations are shown the works as they existed from 1858 to 1861 and from the latter year up to 1870. It will be noticed that a considerable portion of the site was available for further extensions.

In 1864, various changes were made in the terms of the Company's Treaty, especially in regard to the quality and pressure of gas, the extension of the mains, and the public lighting. In this connection, a Committee was appointed, upon which were the two celebrated chemists MM. Dumas and Regnault. The war which broke out six years later naturally put a sudden stop to the commercial prosperity which had marked so conspicuously the administration of M. Weill-Goetz, who by the year 1869 had brought up the consumption of gas to nearly 64¼ million cubic feet. In the period from 1858 to 1869, oil lighting gradually gave place to gas, as shown by the following figures giving the expenditure on this branch of the service: 1858—Oil, 22,686 frs.; gas, 25,183 frs. 1865—Oil, 13,097 frs.; gas, 46,866 frs. 1869—Oil, 890 frs.; gas, 60,084 frs. On Aug. 6, 1870, Baron Pron, the Prefect of the Lower Rhine, made known to the inhabitants that the city was in a state of siege; and six days later the Mayor (M. Humann) addressed a letter to M. Weill-Goetz, by order of the General in command, requesting him, in the event of the enemy opening fire, to take the necessary steps for liberating all the gas contained in the holders. Next day the cannon roared from the ramparts, within a few yards of the gas-works. The effect has been vividly described by M. Gustave Fischbach in his work entitled "The Siege and Bombardment of Strasburg." He says that the streets after dark presented a strange appearance. On the night of the 14th of August the order to empty the holders was carried out; and to the *façade* of each house was affixed a lantern. The writer says that though these lamps, which were of all shapes, sizes, and ages, and fixed at various elevations—even as high as the third floor—did little more than make darkness visible, their effect was so novel and *bizarre* that the inhabitants were to a certain extent consoled for the absence of gas. As the attack on the fortress was made on the north side, and the breach by which the enemy purposed making the assault was close to the gas-works, they necessarily suffered severely. Out of the 200,000 projectiles thrown into the city, a considerable number crashed into the works' buildings and the gasholders. In the forty days during which the bombardment lasted, the neighbourhood of the works was destroyed.

Eight days after the capitulation, the ever-memorable Herr Küss, a Professor at the Faculty of Medicine, who, on the 14th of September, succeeded M. Humann as Mayor, addressed a letter, dated Oct. 7, 1870, to the Manager of the gas-works, directing his attention to the importance of restoring, with as little delay as



Strasburg Gas-Works, 1858-1861.



Strasburg Gas-Works, 1861-1870.

possible, the supply of gas to the city, and informing him that he had appointed a Committee to take the necessary steps to this end. He urged the Manager to employ all the means in his power to bring the works again into proper condition for making gas. As it would be some time before a full supply of gas could be assured, the public lighting had the first attention. The city was divided into four districts, and specific directions were given in regard to dealing with them in the order of their importance; and either oil or petroleum could be employed, so that the lighting might be restored. The repair and replacement of the damaged pillars, &c., were paid for by the Municipality.

Surrounded by two nations at war, the greatest difficulty was encountered in carrying out the orders of the Mayor; and it became necessary to turn to England for help, especially for the supply of the gasholder, which was the first thing needed, and to obtain the necessary special safe-conducts for expediting the arrival of the material for the construction of the railway. The work of reconstruction was carried out by M. Louis Weill-Goetz, the son of the Manager, under the direction of the Company's Engineer-in-Chief, Mr. Hodgson Jones. Though the repair of the damaged mains was difficult, on account of the severe weather prevailing, the supply of gas was restored on Dec. 24, 1870.

M. Weill-Goetz, sen., retained the management of the undertaking, which every year increased in prosperity, until July 21, 1875; and he had so trained his son that he might succeed him.

As already mentioned, M. Louis Weill-Goetz had assisted in the reconstruction of the works after the bombardment, and for some time he held the post of Works Manager. He afterwards obtained experience as an Engineer in the Company's works at Nîmes and Genoa, and returned to Strasburg in 1875 to take the place which his father had occupied for seventeen years, and in which he had shown so much zeal and devotion. At that time, Strasburg had 85,500 inhabitants, of which about 9000 were soldiers. One of the early results of the new management was the purchase of the gas-works of M. Müller at Schiltigheim, in order to throw them out of use, and connect this industrious commune with the works at Strasburg. M. Louis Weill-Goetz held his position for twenty years; and thanks to his energy and far-sightedness his management was marked by uninterrupted success. In 1877, the sale of gas reached 106 million cubic feet; and it was increasing rapidly with the general extension of the city. In 1897, when the number of inhabitants was 125,000, the consumption had risen to very nearly 283 millions.

In 1877, the works were laid out for a production of about 882,000 cubic feet of gas per day. All the appliances in use at that date have disappeared, with the exception of the two station meters, each of 425,000 cubic feet capacity, the 210,000 cubic feet holder (subsequently telescoped so as to bring its capacity up to 315,000 cubic feet), and the five station governors. The present vast purifier-house, which is the admiration of all connoisseurs, was erected in 1887, as was also the sulphate of ammonia plant, which is considered to be a model of its kind. In 1889, there was put up a Pelouze and Audouin tar-extractor of about 882,000 cubic feet capacity, and the construction was commenced of the large telescopic holder, which is now capable of containing 847,000 cubic feet of gas. The first settings of retorts on the Klönne recuperative system were put up in 1893. The "Standard" washer-scrubber, having a daily capacity of rather more than 700,000 cubic feet, dates from 1894, as does the third 425,000 cubic feet station meter. In 1896, a new series of the old grate-bar furnaces were replaced by others on the Klönne system, for heating which there was never used more coke than 12½ per cent. by weight of the coal carbonized. The following year, the works were brought up to a maximum production of close upon 2 million cubic feet per day. In order to make this possible, it was proposed to remove a portion of the works to a site outside the city, as they were much cramped by reason of the proximity to them of the railway station and the line, by which they were surrounded. Fortunately, the station was removed in 1884; and M. Louis Weill-Goetz at once profited by the event, and acquired the land necessary to enable him to obtain room for extensions. By this judicious operation, the site was increased from about 3½ to 8½ acres.

Among other good strokes of business effected by M. Weill-Goetz, was the conclusion, after some very delicate negotiations, of an agreement for the prolongation of the Company's concession, which was originally granted for fifty years, and would have terminated at the end of 1907. In 1885, the period was extended by twenty-five years—viz., to Dec. 31, 1932. Under the new Treaty, the consumers have obtained progressive reductions in price from 5s. 7½d. to 4s. per 1000 cubic feet, and the system of having two meters, one for lighting and the other for heating gas (the latter supplied at a reduced price), was introduced. The effects of this innovation were not appreciable until after M. Weill-Goetz had induced the Company to open, on April 1, 1892, large show and sale rooms in the Old Wine Market, one of the principal business thoroughfares in Strasburg. A thoroughly qualified demonstrator in cooking was engaged to give practical lessons, with the result that the use of gas for culinary purposes increased considerably; and in 1897 the promoter of this increase was able to register the first million cubic metres (35·3 million cubic feet) as the annual consumption of gas in this way. At the time no one thought that the quantity of gas used for cooking and heating would exceed that employed for lighting; yet in 1901 the two applications of gas had each reached about 176½ million cubic feet. But at the time the book now under review was passing through the press, the quantity of heating gas consumed was nearly 318 millions a year; whereas that used for lighting was only 212 millions.

In 1897, the Directors of the Company, being desirous of securing the services of their very able Manager at Strasburg, invited him to take a seat at the Board. M. Weill-Goetz indicated his successor; and before leaving the city he gave a farewell dinner to his co-workers and subordinates. In 1903, he was nominated a Chevalier of the Legion of Honour; and he is now the President of the Union des Gaz. In this position he has had only three predecessors in the fifty years' existence of the Company—viz., MM. F. Toché (1862 to 1889), E. Breittmayer (1889 to 1899), and A. Salanson (1899 to 1908).

So much for the general progress of gas supply in Strasburg. In a subsequent issue, some particulars will be given of the works as they now stand.

In the second part of the report of the Local Government Board for 1908-9 (issued last week), the usual comparison is made between national and local indebtedness. Thirty years ago, the local debt of England and Wales amounted to £136,934,070; while the National Debt of the United Kingdom was £770,604,774. At the end of 1906-7, the local debt had increased to £494,487,512, and the National Debt to £779,164,704. In the 27 years under comparison, the National Debt had increased by £8,559,930, and the local debt by £357,553,442.

EFFICIENCY TRIAL OF A SETTING OF EIGHTEEN VERTICAL RETORTS AT MARIENDORF.

A COMMUNICATION by Mr. E. Körting, the General Manager of the works of the Imperial Continental Gas Association in Berlin, to the "Journal für Gasbeleuchtung" of the 1st inst., contains his observations on different modern methods of carbonization, including the Woodall-Duckham and Dessau vertical retort-settings, the Glover horizontal retorts, and large carbonizing chambers. The paper concludes with the reproduction of a report by the German Association's Instructional and Experimental Gas-Works at Carlsruhe, on an efficiency trial conducted by that institution at the Mariendorf works at Berlin, on a setting of the Dessau type, containing eighteen instead of the customary twelve retorts. We give a summary of the contents of this report, deferring further notice of the remainder of Mr. Körting's communication.

The Instructional and Experimental Gas-Works undertook the efficiency trial at the request of the Imperial Continental Gas Association, and carried it out from the 31st of October to the 5th of November. The setting differed from the ordinary Dessau type in that it contained eighteen instead of twelve retorts; but it occupied only the same ground area. Instead of two rows (placed one behind the other) each containing six retorts, there were in this setting three rows of six retorts of smaller cross section. In elevation and in dimensions the new setting so closely resembled the previous beds of twelve retorts, that it was installed in a bench between two of the latter, and was only noticeably different through the alteration of the mechanical discharging equipment. For making the trials, this setting was connected with the apparatus of the experimental plant at the Mariendorf works; so that the gas which was produced in the setting was condensed, purified, and measured apart from the gas coming from the other settings. All the precautions taken in the previous efficiency trials on a bench of settings of twelve vertical retorts, which were made in May, 1908, were observed in the present set of observations. [See "JOURNAL," Vol. CIV., p. 256.]

The bed of eighteen retorts had been at work in normal conditions for a considerable time before the experimental run, and had been heated by the use of coke produced as to two-thirds from English (Boldon) coal, and as to one-third from Silesian coal. During the trials, the same coke was used for heating the setting. It contained on an average 12·4 per cent. of ash, and had a calorific power of 12,564 B.Th.U. per pound. The retorts were charged with large coal from the Concordia Mine in Silesia. They had been scurfed eight days before the trials were started. The coke produced in the trials was, by desire of the management of the works, not used for firing the setting (as already mentioned), in order that the regular working of the producer should not be disturbed for the experiment. The Concordia coal used contained 2·91 per cent. of water (on drying at 110° C.); 4·28 per cent. of ash; and 92·81 per cent. of combustible substance or coal proper. The ultimate analysis of the coal showed that its percentage composition was as follows, the figures in brackets being the percentages on the combustible substance or ash-free and dry coal: Carbon, 78·14 (84·19); hydrogen, 4·79 (5·16); oxygen and nitrogen, 9 (9·70); sulphur, 0·88 (0·95). The coking test showed a yield of 65·10 per cent. of coke; the flame being luminous and only slightly smoky. The coke was well caked, and of a shining grey character. The proximate analysis showed a yield of 60·82 per cent. of coke free from ash and moisture, and 31·99 per cent. of volatile matter; or, if reckoned on the ash-free and dry coal, 65·50 per cent. of dry and ash-free coke, and 34·50 per cent. of volatile matter. The coke contained 6·59 per cent. of ash. The net calorific value of the coal was 13,315 B.Th.U. per pound, or, on the combustible coal substance, 14,346 B.Th.U. per pound.

The most suitable time for working off the charge had been ascertained by previous trials to be 10½ hours, with admission of steam during the last two hours. The trials were begun on Oct. 31, at 5.30 p.m., and continued until 2 a.m. on Nov. 5. They thus comprised five periods of 21 hours each. A summary of the results obtained is given in the appended table:—

TABLE I.— *Results Obtained with the Setting of Eighteen Vertical Retorts, Oct. 31 to Nov. 5, 1909.*

[Charges worked off in 10½ hours, with steaming for the last two hours.]

	Total for 105 Hours.	Average for 24 Hours.
Weight of coal (air-dried) charged into the setting	85·575 tons	391 cwt.
Average charge of coal (air-dried) per retort = 1065 lbs.	—	2434 lbs.
Make of gas (at 60° Fahr., 30 in. bar., and saturated)	1,150,180 c.ft.	262,898 c.ft.
Do., do. per ton of coal		13,430 c.ft.
Coke used as producer fuel—		
Per cent. by weight of coal carbonized		11·8
Per 1000 cubic feet of gas		20·02 lbs.
Quality of gas—		
Gross calorific power per cubic foot		542·6 B.Th.U.
Illuminating power in Carpenter burner, at 5 cubic feet per hour		10·0 candles
Specific gravity		·445
Nitrogen in gas		1·2 per ct.

In regard to the figures recorded in this table, it may be observed

that the coal was exactly weighed for each experimental day of 21 hours; and a sample was taken as it was introduced into the coal-bunker. The coal remaining in the bunker at the end of the day was weighed; and the amount was deducted from the weight of coal put in, in order to find the amount charged into the retorts. The charging and discharging of the retorts throughout took place in an entirely satisfactory manner. The temperature of the setting was very uniform all through the trial. The fuel consumed in the producer was ascertained twice for periods of 48 hours. The quantity of coke was weighed, and while being carefully sampled was introduced into a bunker. That remaining in the latter at the end of the period was afterwards weighed and deducted. The producer was clinkered at the start. The quenched coke was collected and weighed in the usual manner; and the quantity was reduced to the equivalent of dry coke. The amount of ash in the coke was determined, and the quantity of quenched coke was calculated to coke of the original contents of ash. The quantity of coke is given on the absolutely dry basis. The weight of coal is that of air-dried coal. The charges of the retorts in the first two 21-hour periods were heavier than in the subsequent ones. It was observed that when the retorts were discharged the coke from the lowest part of them was still giving off gas. Hence on the third day more coke breeze was introduced into the retorts. For the fourth and fifth periods of 21 hours, however, the quantity of coke breeze was reduced again; and the space available for the charge of coal was thus increased. These changes in the amount of the charge, taken in conjunction with the effect of the admission of steam, explain some variations which occurred in the make of gas per ton of coal, especially a difference in the third period. On the average, the amount of coal charged into the setting in 21 hours amounted to 342 cwt.; and per retort per 10½ hours, to 1065 lbs. The yield of gas per 21 hours was 230,036 cubic feet, of an average gross calorific power of 542·6 B.Th.U. per cubic foot. The table shows the total figures for the five experimental periods, and also the results per 24 hours. It will be seen that the quantity of coal carbonized in 24 hours amounted to 391 cwt. for the setting, and 2434 lbs. per retort. The make of gas amounted, on the average, to 262,898 cubic feet, at 60° Fahr., 30 inches bar., and saturated, per 24 hours. The make per ton of coal averaged 13,430 cubic feet, at 60° Fahr., 30 inches, and saturated, with a gross calorific power as already stated. This is equivalent, including the water gas produced by the admission of steam, to 24·4 per cent. of the calorific value of the coal carbonized. The illuminating power and specific gravity of the gas were determined; but the results do not call for comment. The amount of nitrogen in the gas was small, as no air was introduced for purification. The consumption of 20 lbs. of coke in the producer per 1000 cubic feet of gas made shows that for every 100,000 B.Th.U. obtained in the gas 45,700 B.Th.U. were expended in the coke used as fuel.

The following tabular statement gives a comparison of the results obtained in the setting of eighteen retorts with the corresponding results obtained May, 1908, with twelve vertical retorts.

TABLE II.—*Comparative Results of Trials with Dessau Settings of Twelve and Eighteen Vertical Retorts.*

	Setting of Eighteen Retorts.		Setting of Twelve Retorts.
Date of trial	Nov., 1909	..	May, 1908.
Coal carbonized in 24 hours . cwt.	391	..	275
Gas made ,, ,, cub. ft.	262,898	..	190,183
Coke used as fuel ,, ,, . . lbs.	5,185	..	4,341
Gas made per ton of coal (at 60° Fahr. and 30 in.) . . . . . cub. ft.	13,430	..	13,815
Gross calorific power of gas, B.Th.U. per cubic foot	542·60	..	536·70
Coke used as fuel—			
Per 1000 cubic feet of gas made, lbs.	20	..	23
Per 100,000 B.Th.U. in the gas made . . { lbs.	3·64	..	4·25
Per 100,000 B.Th.U. in the gas made . . { B.Th.U.	45,700	..	53,400

The trials were conducted by Dr. K. Bunte and Herr Sentke, of the Instructional and Experimental Gas-Works, with the collaboration of Dr. Geipert, of Mariendorf.

THE SODA INDUSTRY.*

WE have received a copy of the third and much enlarged edition of the second volume of Professor Lunge's exhaustive treatise on "The Manufacture of Sulphuric Acid and Alkali." The first volume, of which also the third edition has already been issued, deals with the manufacture of sulphuric acid only, and is divided into two parts. The second volume, of which the third edition is just published, treats of salt cake, hydrochloric acid, and Leblanc soda manufacture, and is likewise in two parts. The third volume, which up to the present has only reached its second edition, relates to the ammonia-soda and various other processes of alkali making.

The new edition of the second volume naturally does not contain very much matter of direct interest to gas men, since its subject-matter is the branches of the alkali industry generally comprised under salt cake, hydrochloric acid, and Leblanc soda manufacture. Ultimately, as the author points out, it is likely that the process of soda manufacture, which was devised more than 100 years ago by Leblanc, will be entirely superseded by the ammonia-soda process which has already attained the greatest commercial vogue. Nevertheless, the Leblanc process will continue in use for some time to come, and the processes incidental to it are also of considerable importance independently of it. Hence the present volume, comprising two parts and containing 1010 pages, is likely to remain of great interest and value to technical men. Needless to say, Professor Lunge deals with the whole of the subject in a most exhaustive manner, both from the standpoint of the chemicals and the chemical reactions involved and of the plant and mechanical appliances used in the alkali industry. The subject is not one of which the treatment by the author need be critically discussed in the "JOURNAL." We will, therefore, merely indicate the contents of the two parts of the new edition of the second volume of the complete treatise.

The first chapter describes the properties of the raw materials of the alkali industry and their occurrence in Nature, and the properties of the products of the industry. The chief raw material is common salt, and the intermediate and final products include sulphate of soda, hydrochloric acid, carbonates of soda, caustic soda, and thiosulphate of soda. The second chapter describes methods for the analysis of the aforementioned raw materials and products. The third chapter relates to the manufacture of sulphate of soda, or salt cake, from common salt and sulphuric acid. The fourth chapter describes the manufacture of the same material by the process of Hargreaves and Robinson; while the fifth chapter deals with various other methods for the manufacture of sulphate of soda. The purification of sodium sulphate is handled briefly in the sixth chapter. The seventh chapter is one of the longest in the book, and relates to the important matter of the condensation of the hydrochloric acid produced in the manufacture of salt cake. Other methods of manufacturing hydrochloric acid are briefly described in the eighth chapter. The handling and purification of hydrochloric acid occupy the ninth chapter, which completes the first part of the second volume.

The tenth chapter, with which the second part opens, contains general and historical notes upon alkali manufacture, together with an exposition of the theory of the Leblanc process and a statement of thermochemical data relating to it. The next stage of alkali manufacture, in which carbonate of lime and coal are employed to produce black ash from the salt cake, is described in the eleventh chapter. The proportions of these materials used at the present day do not differ greatly from the proportions originally laid down by Leblanc—viz., 100 parts of calcined sodium sulphate, 100 parts of chalk, and 50 parts of charcoal, though bituminous coal equivalent in carbon-content to the charcoal is now substituted for the latter. The black ash resulting from the treatment of this mixture in a revolving or other furnace consists of crude sodium carbonate mixed with varying proportions of calcium sulphide, lime, calcium carbonate, caustic soda, and smaller quantities of other salts and impurities. Black ash and tank liquor, including the lixiviation of the black ash, are dealt with in the twelfth chapter. The thirteenth chapter relates to the manufacture of finished soda and bicarbonate from the tank liquor. A short but, from the manufacturing standpoint, important chapter is the fourteenth, which deals with the yield and costs of alkali making. The fifteenth chapter describes the processes adopted for the manufacture of caustic soda. The sixteenth and final chapter is a lengthy one, in which methods for dealing with tank-waste are described. Processes are fully handled for the recovery of sulphur from oxidized alkali waste, and for the removal of the total unoxidized sulphur of the waste in the form of sulphuretted hydrogen. The utilization of the sulphuretted hydrogen for the manufacture of sulphuric acid by the Claus-Chance process, is also included in this chapter, the final pages of which are devoted to the production of thiosulphate of soda ("hypo.").

The work includes a number of plates and over 300 illustrations of plant, &c. Many misprints and clumsy expressions have escaped the proof reader's attention; but the volume as a whole is well produced and carefully written. Those technical men who are engaged or directly interested in the alkali industry, will be grateful to the author for the thorough manner in which he has carried out his task.

* "The Manufacture of Sulphuric Acid and Alkali with the Collateral Branches." A Theoretical and Practical Treatise, by George Lunge, Ph.D., Professor Emeritus of Technical Chemistry in the Federal Polytechnicum, Zürich, Honorary and Foreign Member of the Chemical Society, London, and of the American Chemical Society. Dr. Ing. (H.C.) of Karlsruhe, &c., &c. Third Edition, much enlarged. Volume II., Sulphate of Soda, Hydrochloric Acid, Leblanc Soda. London: Gurney and Jackson; 1909.

High-Pressure Distribution of Gas in Belgium.—According to a paper on "High-Pressure Gas Distribution," read at the last meeting of the Belgian Association of Gas Managers by M. Feist-Hénoul, there are in Belgium several installations of high-pressure gas, which have been carried out by the Central Gas and Electricity Company, on the initiative of M. De Brouwer, of Bruges. Ypres supplies Poperinghe, Nieuport, Middelkerke, Furnes, La Panne, and Dixmude. Gas is conveyed from Thielt to Meulebeke, Ingelmunster, Pitthem, Ardoye, Winghene, and Aeltre; from Bruges to Thouront, from Gheel to Herenthals and Moll, and from Malines to Lierre. Altogether, there have been laid down nearly 125 miles of high-pressure mains, or rather connecting mains, for several of the installations do not work by compression but by suction. In addition to these long-distance transmissions, the Imperial Continental Gas Association have a large installation in a district of Brussels.

CONTROLLING THE LEVEL OF LIQUID IN THE HYDRAULIC MAIN.

Meunier's Patent Arrangement.

One of the patent specifications issued on the 23rd ult. was that of an invention for "Improvements Relating to Gas Manufacture," for which application was made as long since as Oct. 31, 1908, by Mr. S. Meunier, the Engineer and Manager of the Stockport Corporation Gas-Works; and it is described as relating to "the production of gas by the distillation of coal in gas-retorts, and the collection of the gas by means of a hydraulic main, and the usual scrubbers for delivery into a gasholder."

The patentee points out that "it has been found, in practice that the gas on distribution frequently deposits naphthalene, and this introduces considerable difficulties in the distribution system in town supplies—rendering it necessary to have the various distributing pipes cleaned out at more or less frequent intervals, and is liable to give more trouble at one time of the year than at another."

Many proposals have, he says, been made to get over this difficulty by treating the gas after manufacture with various hydrocarbon liquids; but he has found that, by very simple means applied in the hydraulic main, he is able to obtain and use, owing to the relative absence of fluctuation, a gas pressure very closely approximating to atmospheric, and to obtain an increase in the quantity of gas as contrasted with that obtained in other systems using ordinary hydraulic mains, while in most cases a gas of such quality is obtained that naphthalene practically does not deposit in the mains and an increase in both its illuminating and heating value results—the particular coal gasified to a certain extent determining the precise improvement obtainable. Further, he finds that the liquid in the hydraulic main becomes much richer in ammonia; and this enables the scrubbing plant for a given quantity of coal gasified to be reduced.

The specification continues: It has been proposed heretofore to employ means, in gas-washing apparatus and in hydraulic mains, having for their object the spreading and dissemination of the gas in contact with the main liquor or the lightening of the seal. In all these devices, however, the gas bubbled through the main liquor and escaped from a free surface of the same; and as these devices were in no way adapted to steady the consequent disturbances of the liquid surface, pulsations of pressure in the retort, as well as in most cases excessive back-pressure, resulted—conditions which prevent the obtaining of the maximum yield of gas. It has also been proposed to split up any sudden rush of gas from the dip-pipe into small bubbles without causing any material disturbance of the liquid surface by serrating the lower edge of the dip-pipe and employing a pressure regulator or governor between the retorts and the exhauster.

The present invention consists in providing means—such as floats or baffle-plates—in the hydraulic main, at, or partially below, the liquid level which are adapted to give free egress of the gas, while maintaining a much more uniform liquid-level in the main than exists at present, and ensuring the maintenance of a more even pressure of gas in the retort and a much more thorough contact of the gas with the liquids in the hydraulic main, whereby a more effective removal of impurities from the crude gas is carried out while it is still hot. The invention further consists in providing suitable floats or baffle-plates in the hydraulic main, carrying dip-pipe sleeves in such a way that the dip-pipe seal can be either mechanically or automatically controlled. Where adjustable floats or baffles are used, they are preferably adapted for adjustment in sections.

In carrying the invention into effect, in one form, floats are provided in the hydraulic main—boards which will float in the hydraulic main liquor. The boards substantially cover the liquid surface in the hydraulic main, except for the required spaces through which the gases find exit after coming in contact with the hydraulic main liquor. Instead of employing floats (which, in the case of wooden or like absorbent floats, if allowed to remain unchanged for a lengthy period become saturated with main liquor and sink), baffle-plates may be used, which may or may not be capable of floating, but are fixed—preferably at an adjustable level—by bolts or screws. The adjusting devices should be so constructed that they can be operated from outside the hydraulic main during distillation, whether floats or baffle-plates be used. The adjustments may be either as regards the depth of seal or as regards the extent to which the floats or baffle-plates are immersed in the liquid, and, consequently, as regards the height of the liquid column in the gas-exit spaces of the baffle-plates or floats, or as regards both. The upper surface of the baffle-plate or float is, therefore, never appreciably immersed in the liquid.

The adjustment in the case of floats may be by means of rods or the like passing through stuffing-boxes upon the upper cover of the main bearing upon the upper surface of the float and capable of adjustment, or by any suitable means which "limit the upward movement of the float." In some cases, sleeve pieces, preferably supported from the baffle-plates or floats, may be applied, which slide on the dip-pipes, and enable the dip-seal to be adjusted either automatically or by hand. The former method is, however, preferable. One set of baffles or floats is employed for each bed of the retorts; so that close adjustment may be maintained, notwithstanding differences in the rate of distillation from different sets of retorts.

Fig. 1 represents a sectional elevation and sectional plan of a form of the apparatus in which floats and mechanically adjustable dip-pipe sleeves are employed. Fig. 2 is a sectional elevation of a form employing floats and automatically adjustable dip-pipe sleeves. Fig. 3 is a sectional elevation of a hydraulic main provided with mechanically adjustable baffles, with a sectional plan. Fig. 4 represents, in sectional elevation and plan, a hydraulic main provided with mechanically adjustable baffles and dip-pipe sleeves.

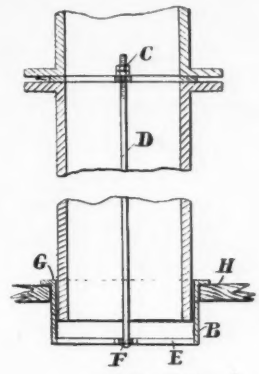


Fig. 1.

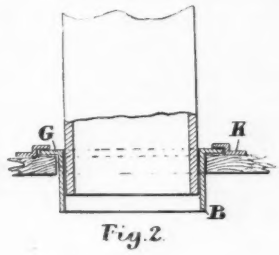
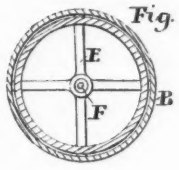


Fig. 2.



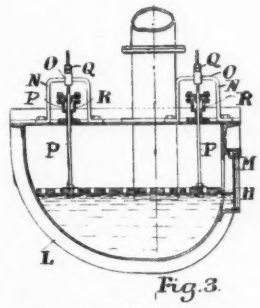


Fig. 3.

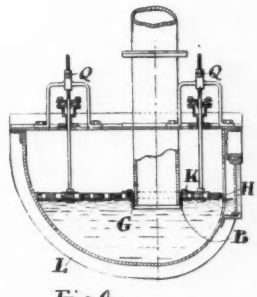
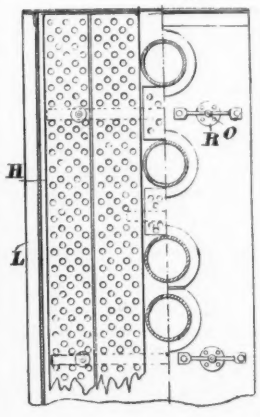
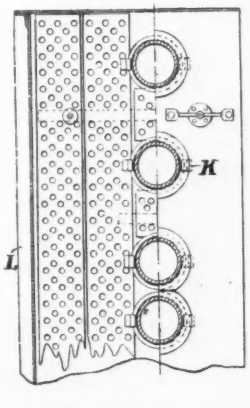


Fig. 4.





Meunier's Patent Hydraulic Main Floats.

In fig. 1, the dip-pipe is shown provided with a sleeve-pipe B adjustable with respect to the dip-pipe by means of a nut C coacting with a projection within the dip-pipe and a further nut (not shown) upon the opposite side of the projection, and with a rod D connected to the sleeve pipes by the four radial arms E and boss F. The sleeve-pipe has a flange G on its upper edge, limiting the upward movement of the float. This apparatus provides means whereby the seal in the hydraulic main may be adjusted by hand as desired; the float H being free to move, except as checked by G, with such variation of water-level as may occur.

In fig. 2 is shown a modification whereby a constant depth of seal is automatically ensured. It consists in providing a float H with a sleeve B having a flange G on its upper edge clamped

between the float and the clamping flange K, and sliding over the dip-pipe; its position automatically adjusting itself to the variations in the liquid level in the main. In fig. 3, L represents the hydraulic main provided with a gauge M to show the level or fluctuation of the liquor in the hydraulic main and dip-pipe, and having upon its upper cover supports N through the bosses O of which pass rods P having their upper ends screw-threaded and provided with adjusting nuts Q. These rods pass also through stuffing-boxes R and support on their lower end the baffle-plates H provided with suitable perforations. This device allows of adjustment of the baffle-plates within the hydraulic main during distillation from the outside.

Fig. 4 shows a similar device; but means are here provided for the alteration of the seal coincidently with the alteration of the position of the baffles. These means consist in a sleeve B clamped to the baffle H by a clamping flange K fixed to the baffle and coacting with a flange G on the upper end of the sleeve B, which latter slides freely upon the lower end of the dip-pipe. By this means, any alteration of the position of the baffle H by the nuts Q results in a corresponding movement of the lower end of the sleeve.

A suitable thickness for the floats is said to be about 1 inch, and the holes provided may also be made of about 1 inch in diameter; while the baffles are preferably adjusted so that the lower surface is at the liquid level.

With the application of this invention to a retort-bench in a gas manufacturing system using a hydraulic main, the patentee says that he has found (for example) an increase in the make per ton by from 10 to 12 per cent.; while the gases produced did not deposit naphthalene in the distributing system.

THE NEED FOR A CALORIFIC STANDARD.

A Report from the State of New York.

The State of New York Public Service Commission (Second District) have made arrangements to hold, on the 1st prox., a conference with representatives of gas companies on the subject of standards for the measurement of the value of gas—the special aim being to obtain an interchange of opinion on the need for a calorific standard, and on all questions necessarily incidental thereto. A preliminary inquiry into the subject on behalf of the Commission has already been completed, and the results are embodied in a report (of which the main portions are here reproduced) by Mr. Henry C. Hazzard, the Chief of Division of Light, Heat, and Power. Before proceeding, it may be mentioned that, in the report, all calorific values are stated as gross.

The Division of Light, Heat, and Power began, in August, 1908, an investigation into the subject of the calorific power and illuminating power of the coal gas, carburetted water gas, and mixed coal and carburetted water gas supply. The particular object of the investigation was to ascertain the relative importance of heating power and illuminating power as a standard for the measurement of the real value of gas. Its general scope included: (1) The making of a series of tests to determine the calorific values of the coal gas, carburetted water gas, and mixed coal and carburetted water gas supplied by the several gas corporations operating within the jurisdiction of the Commission; (2) the making, contemporaneously with each of the calorific tests, a test to determine the illuminating power of the gas; (3) a study of the relation, if such exist, between the calorific value and the illuminating value of the gas; (4) an inquiry into the approximate proportion of the total gas supply that is used for such purposes and in such manner as to make its heating power a factor of prime importance; (5) an examination into the merits of different types of calorimeters; and (6) the ascertaining of the gas heating-power requirements in force in other governmental jurisdictions. The report summarizes the results of the study, which may be regarded as work of a preliminary nature in a broad field of inquiry.

After setting forth what has been done in this country and in Germany in the direction of recognizing the importance of a calorific standard, the report goes on to remark that in the United States the practice of calorimetry is by no means so marked. Several municipalities in different States have prescribed calorific standards with which in the respective communities the gas supplied must comply. Dallas (Texas) and Omaha (Neb.) have respectively fixed standards of 650 and 600 B.Th.U. gross; but the only State which has acted in the matter is Wisconsin, where, until 1908, no statutory requirements whatever as to the quality of gas existed.

In that year, following tests made at various plants in the State, and a most careful examination into the subject generally, the Railroad Commission of Wisconsin adopted a regulation that—"The company furnishing gas which, within a 1 mile radius from the distribution centre, gives a monthly average total heating value of not less than 600 B.Th.U., with a minimum which shall never fall below 550 B.Th.U., may be considered as giving adequate service as far as the heating value of the gas is concerned." As far as the illuminating value of the gas is concerned, the Commission reached the conclusion that "the candle power standard which has been almost universally used in the past for gas measurements is of minor importance in this State," and commented further upon the subject, as follows: "It is possible to secure a high candle-power gas which has but a moderate heating value; and to require companies to maintain a double standard which shall insure both the high heating value and a high candle power, would surround them with such restrictions that economy in manufacture might not be attained. And since but few gas consumers would be benefited by a candle-power restriction, and this number is continually decreasing, no regulations as to candle power are prescribed at this time. It should be added, however, that with a 600 B.Th.U. heating standard, and in view of the conditions under which gas is being manufactured in this State, a fairly satisfactory illuminating value is insured. It is hardly possible to manufacture a coal gas of 600 B.Th.U. which shall not have a candle power of from 12 to 16, or even more. The enrichment of a water gas up to 600 B.Th.U. will insure an even higher candle power."

In New York State, uniformity in the quality of gas has for some years been sought to be secured through general and special laws establishing illuminating power and purity requirements. The subject of gas calorimetry has so far not received Governmental recognition, State or Municipal, except in the city of Auburn, where, by agreement entered into in 1906 between the Municipality and the Auburn Gas Company, it is provided that the mixed gas supplied by the Company in that city shall have an illuminating power of not less than 18 candles and a heating power of not less than 600 B.Th.U. gross. Neither is the practice of gas calorimetry voluntarily followed in this State except by a few of the larger companies. Investigation into the subject was begun, therefore, with practically no information at hand of the heating value of the gas furnished in this State.

Characteristic Features of the Investigation.

Coal gas is supplied in the Second Public Service District by 43 companies, carburetted water gas by 44 companies, and mixed gas by 6 companies. Several of these companies at times vary the kind of gas produced.

The alternative was presented of making a few tests of the gas of each of this large number of companies or a large number of tests of the gas of a few companies. The difficulty of the latter method lay in the selection of the plants; and the former plan was adopted, in the belief that the averages of chance in meeting with exceptional conditions of gas manufacture were approximately equal either way, and that the results obtained under the former plan would fairly represent the mean of all the gas supplied. It was deemed impracticable, in connection with the regular gas inspection work, to make more than one calorific test of the gas of each plant in each of the four seasons of the year, more so by reason of the special candle-power tests planned to be made in each instance for comparative purposes. A Jünkers calorimeter was selected; and the thermometers of the instrument purchased were carefully checked for accuracy. The original results of each inspection, both calorific and candle power, were checked with supplemental tests, and rejected unless falling within the narrow limits of prescribed accuracy. In fact, all reasonable precautions were taken to ensure the collection of data which would put the Commission in possession of accurate and reliable information on the subject.

Upwards of 700 original tests were made and recorded—divided equally between calorific tests and candle-power tests, the results of which are summarized and commented upon.

Calorific Powers of the Gas Supply.

Table I.—*Number of Plants supplying Coal Gas, Carburetted Water Gas, and Coal Gas with an Admixture of Carburetted Water Gas, Number of Calorific Tests made of each Kind of Gas, and Lowest, Highest, and Average B.Th.U.*

—	Kind of Gas.		
	Coal.	Water.	Mixed.
Number of plants	43	44	6
Number of tests	165	173	14
Lowest B.Th.U	514	501	559·5
Highest B.Th.U.	737	802·6	689
Average B.Th.U.	637·8	626·3	622·3

The mean calorific value of the gas supplied within this jurisdiction, determined from all the tests, is 631 B.Th.U. The average B.Th.U. of coal gas exceeds this general average 1 per cent. That of water gas falls below it by 0·7 per cent.; and of mixed gas, by 1·3 per cent. The wide gamut run between the minimum and maximum of B.Th.U. of each kind of gas is illustrated in comparison with the averages in the following table:

Table II.—*Comparison of B.Th.U. Averages.*

Gas.	Average.	Lowest.	Variation from Average.	Per Cent Variation.	Highest.	Variation from Average	Per Cent. Variation.
Coal	637·8	544	93·8	14·8	737	99·2	15·6
Water	626·3	501	125·3	20·0	802·6	176·3	28·1
Mixed	622·3	559·5	62·8	10·1	689	66·7	10·7

The explanation of these figures naturally lies in the fact that

gas calorimetry is practised by only a few of the gas corporations, and these the larger ones, for their own information; and that there exist no legal requirements for the maintenance of a uniform heating power. A further explanation may be found in the table which follows:

TABLE III.—*Number of Tests of each Kind of Gas, showing B.Th.U. of Given Values; the Calorific Values being Arranged Serially in Groups of 25 B.Th.U. each.*

Number of Tests of			Showing calorific values of
Coal Gas.	Water Gas.	Mixed Gas.	
			B.Th.U.
—	5	—	500 to 524
1	4	—	525 to 549
12	20	3	550 to 574
21	27	1	575 to 599
30	41	3	600 to 624
41	24	4	625 to 649
30	19	2	650 to 674
13	17	1	675 to 699
8	7	—	700 to 724
6	3	—	725 to 749
2	3	—	750 to 774
1	2	—	775 to 799
—	1	—	800 to 824
165	173	14	

Analysis of the figures appearing in this table shows that the average range of existing calorific values is between 550 and 700 B.Th.U. The values outside this minimum and maximum, while interesting and important as illustrating the limits of heating power actually being reached, may generally be attributed to exceptional conditions of gas manufacture at particular plants. Several instances may be cited.

The gas of one company supplying carburetted water gas was found upon one test to have a heating power of 802·6 B.Th.U. This company supply a very superior quality of gas the year through, in the endeavour to satisfy the special lighting requirements of large textile factories in the territory of operation. The average calorific value of the gas was found to be 756·2 B.Th.U., and the average illuminating power 28·8 candles. One of the two water-gas companies whose gas upon one test showed a heating power of between 775 and 779 B.Th.U. was found to be making gas of an average calorific value of 701·6 B.Th.U. The average candle power was 23·9. This company, operating in a small community, without special need, distributes gas considerably above the statutory requirements. The other water-gas plant, having upon one test a gas of 775 B.Th.U., upon another test was found to have a gas of only 506 B.Th.U. Upon the former test, the illuminating power was found to be 22 candles; and upon the latter test, 14·9 candles. These instances suffice to show that the exceptional conditions of manufacture heretofore mentioned may be due either to special exigencies, disregard of economies, or laxness in methods.

Referring now to the ten companies whose gas showed heating power of less than 550 B.Th.U., the works and methods employed by all of these companies except one, by reason of the inferior quality of gas supplied, have heretofore been examined by the Commission, resulting in recommendations that specific improvements be made. These instances, therefore, of extreme calorific values in gas may be explained as due to poor management, inadequate plants, or both. Eliminating upon these grounds all those tests showing in the above table calorific values in excess of 700 B.Th.U. and less than 550 B.Th.U., the following table, giving the remaining tests, fairly indicates the results to be obtained under present average conditions of gas manufacture in this jurisdiction.

TABLE IV.—*Number of Tests of each Kind of Gas and Percentage of Total Tests, showing B.Th.U. of Given Values under Present Average Conditions of Gas Manufacture; the Calorific Values being Arranged Serially in Groups of 25 B.Th.U. each.*

Number and Per Cent. of Tests of						Showing Calorific Values of
Coal Gas.		Water Gas.		Mixed Gas.		
Number of Tests.	Per Cent. of Total.	Number of Tests.	Per Cent. of Total.	Number of Tests.	Per Cent. of Total.	
						B.Th.U.
12	8·2	20	13·5	3	21·4	550 to 574
21	14·3	27	18·3	1	7·1	575 to 599
30	20·4	41	27·7	3	21·4	600 to 624
41	27·9	24	16·2	4	28·6	625 to 649
30	20·4	19	12·8	2	14·3	650 to 674
13	8·8	17	11·5	1	7·2	675 to 699

From these figures, it may be seen that, without the endeavour of the gas producers in this State being directed by any statutory or local requirements to the maintenance of a reasonable heating power in gas, all of the above tests, made presumably under normal conditions of manufacture, show calorific values in excess of 550 B.Th.U.; and 77·5 per cent. of the tests of coal gas, 68·2 per cent. of the tests of water gas, and 71·5 per cent. of the tests of mixed gas disclosed heating values of over 600 B.Th.U.

Based upon all the tests made, and not upon the above selected number, we find, reverting to the figures given in Table II., the heating power of the gas supply to be in excess of 600 B.Th.U.—(1) Of coal gas, 79·4 per cent. of all tests; (2) of water gas, 63·6 per cent. of all tests; and (3) of mixed gas, 78·6 per cent. of all tests. We further find that, inclusive of all tests made, the gas supply fell below 550 B.Th.U. in 0·6 per cent. of the tests of coal gas, 5·2 per cent. of the tests of water gas, and not at all in the tests of mixed gas.

COMPARATIVE FIGURES OF HEATING AND ILLUMINATING POWER.

The results of the candle-power tests are summarized in Tables V., VI., and VII., in which are shown, respectively for coal gas, water gas, and mixed gas, the minimum, maximum, and average of the candle powers existing at the time the B.Th.U. values given opposite each candle-power figure were determined. The figures in each table under the column entitled "Number of Tests" represent alike the number of candle-power tests and the number of heat-unit tests.

TABLE V.—*Comparative Results of Contemporaneous Tests of Heating Power and Candle Power of Coal Gas.*

Heating Power.	Number of Tests.	Candle Power.		
		Minimum.	Maximum.	Average.
B.Th.U.				
500 to 524	0	..	..	..
525 to 549	1	11·0	11·0	11·0
550 to 574	12	11·7	19·8	14·5
575 to 599	21	12·4	16·7	15·1
600 to 624	30	12·7	20·4	15 7
625 to 649	40	13·0	17·9	16·2
650 to 674	30	14·3	18 9	16·7
675 to 699	13	16·3	19·2	17·6
700 to 724	8	15·6	19·4	17·1
725 to 749	6	16·7	18·9	17·6
750 to 774	2	17·6	17·7	17·7
775 to 799	1	18·9	18·9	18·9
800 to 824	0	..	..	..

TABLE VI.—*Showing Comparative Results of Contemporaneous Tests of Heating Power and Candle Power of Water Gas.*

Heating Power.	Number of Tests.	Candle Power.		
		Minimum.	Maximum.	Average
B.Th.U.				
500 to 524	5	14·1	20 8	16·7
525 to 549	4	12·1	16·6	15·0
550 to 574	20	14·4	21·6	19·0
575 to 599	27	15·5	24·0	20·2
600 to 624	41	11·1	23·6	20·4
625 to 649	22	17·6	31·5	21·5
650 to 674	19	19·1	25 5	21·5
675 to 699	17	20·2	26 9	22·4
700 to 724	7	19·5	25·8	22·9
725 to 749	3	22 3	29·6	26·7
750 to 774	3	25 1	30 5	27 1
775 to 799	2	22·0	27·0	24·5
800 to 824	1	27 1	27 1	27·1

TABLE VII.—*Showing Comparative Results of Contemporaneous Tests of Heating Power and Candle Power of Mixed Gas.*

Heating Power.	Number of Tests.	Candle Power.		
		Minimum.	Maximum.	Average.
B.Th.U.				
550 to 574	3	13·7	19·2	16·6
575 to 599	1	16 7	16·7	16 7
600 to 624	3	15 2	20·6	17·4
625 to 649	4	18·7	21·3	20·5
650 to 674	2	18 8	21·6	20·2
675 to 699	1	19 8	19·8	19·8

Referring to Table V., the statutory illuminating power required in coal gas is 16 candles. The average candle power findings show that this standard is not reached except where the coal gas has a calorific value of 625 B.Th.U. or over. The averages of the candle-power readings also show a remarkably uniform increase in candle-power value in keeping with the increase in calorific values. The importance of the apparent relation between the two values becomes less pronounced, however, upon attention being given to the maximum and minimum candle-power figures where the variations are wide.

The same conclusions are arrived at on a study of Table VI.—the water-gas results. An apparent relation is here also discernible between the candle power of water gas as given in the column of averages and the heating value of the gas. With the exception of the lowest and one of the highest groups of values, there is shown a gradual and regular increase in candle power relative to the increase in calorific values; and this evidence of relationship also is considerably shaken in contemplation of the wide variation between the minimum and the maximum candle-power determinations, particularly in connection with the lower

calorific values. The legal illuminating power for water gas is 20 candles; and from the average candle-power results, it appears this illuminating power is not found in gas of a lower calorific value than 575 B.Th.U.

The legal illuminating standard for mixed gas is 18-candle power. The tests made show that this standard was reached in gas having a calorific value a little in excess of 600 B.Th.U.

To further show the connection, if any exists, between the heating power and the illuminating power of gas, averages and group values are departed from in the table following, and individual determinations given for coal gas and water gas. The highest and lowest calorific values of the gas of each company are arranged in order of their value; and opposite each is shown the candle power of the gas existing at the time.

TABLE VIII.—*In Further Illustration of the Relation (if any) of the Illuminating Power and the Heating Power of Gas.*

Coal Gas.				Water Gas.			
Highest B.Th.U.	Candle Power.	Lowest B.Th U.	Candle Power.	Highest B.Th.U.	Candle Power.	Lowest B.Th.U.	Candle Power.
585 0	16·2	544·0	11·0	592·0	20·3	501·0	14·1
597·0	13·9	550·7	12·3	595·5	20·4	506·0	14·9
616 0	15·6	552·0	12·0	597·0	17·6	516·0	17·4
627·0	14·1	559·0	13·6	601·5	20·4	518·5	16·2
630 0	14·4	561 0	16·4	606 5	15·5	519 5	20·8
630·0	16·9	561·5	15·4	613·5	22·3	526·5	16·2
632·0	13 0	562 0	17 0	615·5	20·3	533 5	16·6
635·0	15·2	563·5	14·7	617·5	20·3	544 4	12·1
636·5	16 2	569 0	14·3	621·5	17·3	552 0	20·5
639·5	16·8	572·0	19·8	623·5	23·6	554·0	20·9
641·0	16·0	574·5	16·3	624·0	20·9	559·0	21·3
646·0	13·9	574·5	16·3	627·0	19·4	563·0	19·7
647·0	14·4	577·0	16·1	630·0	19·8	564·0	20·6
651·0	15·4	582·0	12·4	633·0	31·5	566·0	19·4
653·5	16 5	583·5	16·2	633·5	22·0	568·5	18 4
654 0	16·4	584·0	14·7	636 5	..	569·5	21·0
655·0	17·1	588·0	16·1	637·1	21·3	571·0	21·6
656·0	14·4	588·0	16·2	639·5	21·7	572 0	17·5
658·0	15·9	589·0	12·4	639·5	23·3	574·0	20·6
659·0	16 0	591·0	14·3	642·0	20·9	578·0	21·7
662·5	16·7	592·0	13·0	645·0	20·3	579·0	19·0
663·3	17·8	592·0	16·3	645·5	20·2	581·5	20·5
667·0	17·3	594·0	14·4	649·0	20·8	587·0	20·6
670·5	18 3	597·5	16·4	651·0	19·1	587·5	19·3
671·0	16·5	601·5	13·3	662·0	20·0	588·0	20·8
675·0	16·9	604·0	16·2	666·0	21·6	588·5	18·9
688 0	16·8	608·0	13·2	667·5	22·9	589 0	20·8
690·5	17·9	608·5	16 7	675·0	20·2	589·6	20·8
691·0	19·2	611·5	16·2	676·5	23·0	590·0	20·9
695·5	17·0	614·0	17·3	678·5	22·3	592·0	23·5
698·0	18·0	621·5	16·9	681·0	22·8	593·5	18·9
713 5	16·4	625·0	16·4	692·0	22·2	604·0	20·7
715 5	16·5	625·0	17·2	693·0	21·5	604·5	20·4
717·5	16·8	630·5	17·1	707·0	21·8	620·9	20·2
717·0	15·6	631·0	17·3	709·0	24·3	622·3	21·6
719·5	16·9	633·0	..	710·5	21·6	627·0	20·7
727·5	17 4	635·0	17·2	712·0	19·5	635·0	21·8
727·5	16·7	642·5	16·0	713·0	22·2	636·5	20·4
727·5	17·1	644·0	17·2	714·0	25·8	637 0	21·9
729·0	17·8	651·5	17·0	734·0	22·3	637·5	21·0
737·0	18·9	665·0	16·2	761·0	25·8	649·0	26·5
758·0	17·7	690·5	17·9	775·0	22·0	667·5	22·9
794·0	18·9	717·0	18·4	786·5	27·0	676·0	26·0
..	..	..	..	802·6	27·1	729·5	29·6

If any conclusion is to be drawn from these tables of comparative values, it is that the heating power of gas naturally follows, and therefore has some connection with, the illuminating power. That there is no definite relation between them, is the concurrence of engineering opinion. The unknown value of one cannot be calculated from the known value of the other. The temperature of the air, the quality of the coal used, and the general character and methods of manufacture, all enter as conditions to disturb and render uncertain, with varying effect in the different kinds of gas, any fixed relation.

Use of Gas for Fuel and Heating.

The relative importance of heating power standards and illuminating power standards depends naturally upon the proportion of the gas supply for which each standard is the proper measure.

In the early days of the gas industry, when gas was used solely for lighting, and only in open-flame burners, its value lay entirely in its illuminating power. As modern inventions made gas available as a fuel, its heating value became of significance. To-day it is by no means exceptional to find the greater portion of the output of a company used for heating and fuel purposes. The success of the incandescent method of lighting is dependent largely upon the heating power of the gas; and in the extensive use of mantles, the illuminating power of gas has finally become in not a few communities a factor of minor importance. This is particularly true abroad, where, especially in Germany, gas consumers, encouraged by the distributing companies, are nearly all using burners on the incandescent system. In Germany, by reason of this situation, most of the gas is supplied according to its heating value; and, as has been pointed out, the tendency is very marked toward the general adoption of this standard in England.

Is the situation the same in the United States? We have noted the action of the State of Wisconsin in recognizing the necessity of a calorific standard. Of other precedents there are none of significance. To obtain information on this point, a request was made to each gas corporation under the supervision of this Commission to report upon blank forms provided for the purpose the proportion of its gas used—(1) for fuel and heating purposes, and (2) for lighting. Of the gas used for lighting, the report required to be shown, if possible of determination, the proportion consumed in—(1) mantles, and (2) open-flame burners. While at best the reports would consist of close estimates, especially as to the percentage of gas used in mantles and in open-flame burners, the reports were not all satisfactory. Several of the companies failed to respond at all; and a number gave returns which upon the face of them were unreliable. From the remainder, there have been selected those estimates which may be fairly regarded as having been carefully made, and as best representing the opinions of practical gas men in this district.

TABLE IX.—*Showing in Percentages the Proportionate Amounts of Gas Used for Heat and Fuel in Mantles and Open-Flame Burners, as Estimated by the Several Companies Named; the Arrangement being in the Order of the Amount of Gas Output Expressed in 1000 Cubic Feet.*

Company.	Annual Gas Output (1000 Cubic Feet).	Per Cent. of Total Used for		
		Heat and Fuel.	Lighting.	
			In Mantles.	In Open-Flame.
Rochester	984,307	50	10	40
Syracuse	508,735	60	20	20
Troy	291,711	32·4	40	27·6
Binghamton	160,411	40	50	10
Poughkeepsie	99,305	50	25	25
Fulton County	89,891	60	20	20
Watertown	80,801	60	36	4
Chuctanunda	70,949	45	34	21
Newburgh	67,015	50	40	10
Kingston	58,937	45	45	15
Lockport	51,691	55	18	27
Ithaca	49,975	25·5	68·1	6·4
Saratoga	40,925	62	22·7	15·3
Peekskill	35,733	33·7	36·4	29·9
Orange County	30,489	55	20	25
People's (Oswego)	30,031	50	25	25
Northern Westchester	25,033	35·9	27 9	36·2
Homer and Cortland	24,473	19	73	8
Plattsburgh	22,714	57·2	15·6	27·2
Oneonta	13,062	33·3	61·7	5
Canandaigua	9,145	59	15	26
Corning	8,472	0·1	90	9·9
West Shore	6,824	30	50	20
Huntington	6,588	44·5	34·7	20·8
Brockport	6,000	30	40	30
Saugerties	5,613	41	50	9
Geneseo	3,801	26·9	68	5·1
Warsaw	1,452	25	72	3

Conclusions and Recommendations.

A general survey of the entire study leads to the following conclusions:—

1.—That, of the coal gas, carburetted water gas, and mixed gas furnished within the territorial jurisdiction of this Commission, the proportion used in open-flame burners probably does not exceed 20 per cent. of the total supply.

2.—That the existing photometric standards by which is judged the illuminating power of the gas afford the proper basis of measuring the real value of this proportion of the supply.

3.—That unless, and until, the amount of the gas supply used in open-flame burners becomes diminished considerably below its present proportion of the total gas consumed, it is desirable the existing photometric standards be maintained.

4.—That the present test for illuminating power is not suited to a determination of the real value of gas used in the various methods now employed in incandescent lighting, nor does it afford a proper standard of measure for gas used for heat and power.

5.—That the amount of gas used in these methods, and for these purposes, constitutes fully 80 per cent. of the total supply.

6.—That the real value of this portion of the gas supply lies in the heating properties of the gas, for which no standard of measurement exists in this State.

7.—That by reason of the large class of consumers to whom the value of gas as a generator of heat is a matter of primal importance, it is desirable that the calorific power of gas be standardized by the introduction of appropriate tests.

These conclusions directly confront us with the questions:—

1.—What authority has the Commission to prescribe a calorific standard for the gas supplied under its supervision and within its jurisdiction?

2.—If the authority exists, shall a calorific standard be prescribed by the Commission?

3.—What is the proper calorific standard?

4.—Shall such standard be enforced supplemental to the illuminating standard now in use?

The powers of the Commission relating to gas standards are

defined in subdivision 3, section 66, article 4, of the Public Service Commissions Law, as follows—

Sec. 66, *General Powers of Commissions in Respect to Gas and Electricity.*—Each commission shall within its jurisdiction . . . . (3) Have power to fix the standard of illuminating power and purity of gas, not less than that prescribed by law, to be manufactured or sold by persons, corporations, or municipalities for lighting, heating, or power purposes . . . . and by order to require the gas so manufactured or sold to equal the standard so fixed by it, and to establish the regulations as to pressure at which gas shall be delivered.

From this it appears that the Commission at present is without authority to fix any standard for gas other than "the standard of illuminating power and purity."

In view of the conclusions above expressed, Mr. Hazzard recommends, and urges the importance of securing, such amendments to those provisions of the law as will vest the Commission with the broad authority to ascertain and fix adequate and serviceable standards for the measurement of gas, pursuant to which such action may be taken, in the discretion of the Commission, as will serve to carry out the evident intent of the law as it now reads—that a standard shall be established for gas sold "for lighting, heating, and power purposes."

Until such time as the Legislature may act in this matter, it will not be necessary to decide as to the calorific standard proper to be prescribed for the gas supply of this district. This and other considerations may, meantime, be matters of further study and investigation. There is no generally accepted standard of calorific value for gas; and the precedents established by other Governmental bodies do not of necessity afford a criterion as to what the action of this Commission should be. A determination of this question must be based solely upon the conditions of gas manufacture and distribution of this State; and the utmost care must be exercised that the standard adopted shall, on the one hand, insure excellence of service, and, on the other hand, not impose onerous conditions.

The probable effect of the enforcement of a calorific standard upon the costs of plant operation; the advantages (if any) of reasonable and uniform thermal units as against high candle-power units; the objections (if any) to the enforcement of a double standard; the experiences of the local gas manufacturers in determining and regulating calorific values; the present plant equipment and facilities for making heat-unit tests; and the time necessary to adapt gas-works conditions to calorific conditions—are, among others, subjects to which the attention of the Commission should further be addressed prior to any final action. Upon all these matters, the distributing companies whose interests would be affected should be given the opportunity to be heard.

STREET LIGHTING.

An American Paper.

At the Fifth Annual Meeting of the National Commercial Gas Association, of New York City, the following paper on "Street Lighting" was submitted by Mr. E. N. Wrightington.

A history of a recent street lighting campaign in Boston may be instructive. The campaign began by an investigation on the part of representatives of both the electric interests and the Gas Company of the street lighting conditions in Europe. As far as gas is concerned, it was found that the present tendency in Europe is towards the inverted lamp, both with high pressure and with low pressure. The simpler application is, of course, with the low pressure; and it was therefore determined to make a trial installation of low-pressure inverted lamps.

The weakest point for attack in electric street-lighting systems seemed to be the enclosed carbon arc. This light, with its sharp shadows, constant flickering, and uneven distribution, offered a particularly good opportunity to make a satisfactory comparison with gas. It was evident that a large number of small gas units distributed at more frequent intervals would give a very much better lighting effect than the arcs.

Tabulations proved that a two-mantle light, while not operating to as great advantage in the way of even distribution, would cost considerably less to instal and maintain than two units with single mantles each, and would be the best all-round competitor of the electric arc. It was calculated that under the conditions in Boston, with gas at 80 cents and labour at the high price of $2 a day, the two-mantle inverted lamps could be operated at about $35 per year, including fixed charges, gas, labour, and all other expenses. The price for enclosed electric arc lights was about $118. It was anticipated that this price would be considerably reduced on a new contract; and the two-burner gas-lamps were accordingly installed at about the ratio of three lamps to displace one electric arc.

An installation made on this basis and compared with the enclosed electric arc was very satisfactory from the gas point of view. It was admitted on all sides, and, as later developments showed, even by the electric people themselves, that the gas-lamps were superior to enclosed arc lamps. The light was softer, steadier, more evenly distributed, and of better colour.

Meanwhile, the electric interests had not been idle; and finding themselves at a disadvantage, they brought into the field a new type of 6·6/10 ampere magnetite arc, with opalescent globe, and replaced the old enclosed carbon arcs with the new magnetite arc in a section where our installation had been made. This light has still the great disadvantage of all large-unit light sources at considerable distances apart; but as the total volume of light given was much more than that of the old arc, the effect was to increase the illumination.

We contended that the small units at more frequent intervals, whether with gas or electricity, would give the best results; but the city authorities, with whom the tests rested, preferred the larger units. We therefore suggested the use of high-pressure gas. We admitted, however, that high-pressure gas for street lighting in America was not in a sufficiently advanced stage for us to be able to make any price covering the whole city. We offered to light the Boston Common with an experimental installation, provided the city would sign a short-time contract with the Electric Company which would allow us to put in a price for high-pressure lighting after the experience of the trial installation had determined a fair price under American conditions.

The city was unwilling to wait, however; and an electric contract was signed for the same number of lamps as before—about 3000 in all, and displacing most of the old enclosed carbon arcs with the magnetite arcs. The flame arc lamp was brought into the competition; but only a few of them were contracted for. It should therefore be remembered, in any comments made on the street lighting situation in Boston, that the experimental gas installation was on low-pressure gas and was never intended to compete with magnetite or flaming arc lamps, but only with the enclosed carbon arcs, which it did very satisfactorily. It is manifestly unfair to compare the latest electric appliances, only patented in February, 1909, with anything but the latest gas lighting appliances—high-pressure gas.

Shortly after the electric contract was signed, the gas contract for about 12,000 lamps expired. In connection with the renewal of this contract, the competition with gas and electricity was renewed as between the smaller lamps—the tungsten and the single mantle. Here the gas interests were at a disadvantage from the fact that, under the terms of a new city Charter, which had been passed by the State Legislature, no municipal contract could be made for a longer term than to Feb. 1, 1910. By a clause in the electric contract previously signed, the city could increase the number of tungsten lamps so as to displace the gas-lamps. This contract, being on a five-year basis, gave the Electric Company a decided advantage. It was finally arranged, however, to extend the present gas contracts to Feb. 1, 1910, and at that time to ask for bids for a long-time contract.

During the campaign, so many statements were made regarding the relative efficiency of the respective lamps, which did not seem to agree, that we employed a firm of engineers, whose authority could not be questioned, to make tests of both gas and electric street-lamps. A large number of tests were made, both on the street and in the photometer-rooms; and the results will no doubt prove of value.

The following tables are extracted from these tests, with the exception of the indoor test on the upright single-mantle lamp, which we tested ourselves.

Table of Tests—Small Units.

Table I.

Single-Burner Upright Gas-Lamp.

Candle power at 20° below the horizontal.

	Outdoor Tests.
Average of all results	74 c.p.

Distribution of Light in Vertical Plane.

Angle Below Horizontal.	Outdoor. C.P.	Indoor. (Our own test.) C.P.
10°	82	—
15°	76	—
20°	74	74
30°	75	—
45°	81	—
60°	56	—
Approximate M.L.H.S.C.P.	70·7	
Consumption		3·3 ft.
Candle power per foot 20° angle		22·4 c.p.

Table II.

Single-Burner Inverted Gas-Lamps.

Candle power at 20° below horizontal.

	Outdoor Tests.
Average of all results	94·5 c.p.

Distribution of Light in Vertical Plane.

Angle Below Horizontal.	Outdoor. C.P.	Indoor. C.P.
0°	—	73
10°	98	86
15°	96	90
20°	99	95
30°	117	102
40°	—	121
45°	135	—
50°	—	127
60°	137	126
70°	—	124
75°	161	125
90°	165	127
Candle power M.L.H.S.C.P.	118	105
Gas consumption per hour		3·66 ft.
Candle power per foot M.L.H.S.C.P.		28·7 c.p.
At 20° angle		26·0 c.p.
Maximum		34·7 c.p.

TABLE III.

TWO-BURNER INVERTED GAS-LAMP.

Candle power at 20° below horizontal.
Average of all results:

	Outdoor Tests.
In plane of mantles	153 c.p.
In plane perpendicular to plane of mantles	175 c.p.

These lamps were not adjusted at this time to American conditions, but were tested just as they came from the Custom House.

DISTRIBUTION OF LIGHT IN VERTICAL PLANE.

Angle Below Horizontal.	Outdoor. C.P.	Indoor. C.P.
0°	—	176
10°	—	195
15°	—	203
20°	186	220
30°	205	242
40°	—	252
45°	213	—
50°	—	253
60°	230	255
70°	232	253
80°	—	251
90°	216	257
Candle power M.L.H.S.C.P.	193	226
Gas consumption per hour		6·6 ft.
Candle power per foot M.L H.S.C.P.		24·3 c.p.
At 20° angle		33·3 c.p.
Maximum		40·2 c.p.

Large Units (High-Pressure Gas).

TABLE IV.

THREE-BURNER PRESS GAS-LAMP.

Angle Below Horizontal,	Indoor Test. C.P.	
0°	3520	
10°	3780	
15°	3930	
20°	3880	4300
30°	4070	
40°	4050	
50°	3740	
60°	3800	
70°	2870	
80°	2240	
90°	2320	
Candle power M.L.H.S.C.P.	3520	
Gas consumption per hour	70·3 ft.	
Candle power per foot M.L.H.S.C.P.	50·1 c.p.	
At 20° angle	52·2 c.p.	61·2

Pressure, 72·1 inches of water.

TABLE V.

ONE-BURNER PRESS GAS-LAMP.

Candle Power at 20° Below Horizontal.	Outdoor Test.
Average of all results	1521 c.p.
Gas consumption per hour (estimated)	25 ft.
Candle power per foot at 20° angle	60·8 c.p.

TABLE VI.

MAGNETITE ELECTRIC ARC, WITH OPALESCENT GLOBES.

Candle power at 20° below the horizontal.

	Outdoor Test.
Average of all results (except fluctuations)	1059 c.p.

DISTRIBUTION OF LIGHT IN A VERTICAL PLANE.

Angle Below the Horizontal.	Outdoor Test. Best Lamp. Normal. C.P.	Best Lamp. Fluctuation. C.P.	Worst Lamp. Normal. C.P.	Worst Lamp. Fluctuation. C.P.
10°	1,036		781	
15°	1,020		765	
20°	1,161	{432 {294	838	{392 {372
30°	1,250	793	875	
45°	1,200		923	
60°	1,130		798	{273 {221
75°	1,130		738	
90°	975		786	
Approximate M.L.H.S.C.P.	1,150		835	

It will be noted from the above tests that the efficiency of the upright gas-lamp at the useful angle for street lighting of 20° below the horizontal, is 22·4-candle power per foot; that of the single inverted gas-burner at the same angle is 26-candle power per foot; and that of the two-mantle lamp, is 33·3-candle power per foot. While conditions of the tests in the photometer-room were more favourable than in the case of lamps burning out of doors, it will be noticed that in some cases the outdoor tests gave higher candle power results than the indoor tests. Comparison has sometimes been made by the electric interests to the disadvantage of gas lighting by measurements taken of gas-lamps in poor condition or in old-style burners. While the outdoor tests mentioned in the paper were made under good conditions, we would not expect any great depreciation in candle power for the lamps if given satisfactory care during their operation.

From what the electric people say, one would imagine that the electric lamps, and especially the tungsten lamps, were subject to no depreciation whatever. As a matter of fact, tests which were made of tungsten lamps show a depreciation in some cases as high as 30 and 40 per cent. It will be noticed from the above figures that either of the single-burner gas-lamps, upright or inverted, will give more light than the 60-candle power tungsten lamp. In dealing with the question of candle power, a very important point, however, should be considered in comparing the two sources of light—that is, the quality. It has been shown by actual demonstration, and we believe to the satisfaction of impartial observers, that a gas-mantle lamp, even where the candle power is the same, gives a great deal better light than the tungsten lamp.

A number of gas-mantle lamps were installed in Boston, and next to them in the same street a number of tungsten electric lamps. Both these sets of lamps gave practically the same candle power; but the gas-lamps were markedly superior to the electric lamps, not only in freedom from the glare which is prevalent with the tungsten street-lamps, in which the light source is not shaded from the eye, but also in the distribution of the light. This is a case where the most accurate photometric measurements do not show the real effect in the comparison of the two light sources.

When we come to the larger units, and consider the use of gas under pressure, we reach practically untried conditions so far as this country is concerned. In Europe, competition between high-pressure gas and flame arc lighting is very keen; extremely large units being used in both cases. So far, gas has a decided lead. In Berlin, they have just appropriated $250,000 a year for four years to instal gas exclusively; and in London a Committee appointed to consider the comparative merits of gas and electricity have decided in favour of gas. In this country I do not believe that we shall ever have the need for the very large amount of light which is used in European cities. Consequently, the flame arc lamp and the largest high-pressure gas-lamps with three burners will probably not come into very general use for street illumination. I believe, however, that a one-burner high-pressure gas-lamp will prove a valuable competitor with electric arc lighting, both of the carbon and the magnetite types.

Here we have a lamp, as shown by the tests, of some 1500-candle power, which can be produced with 25 cubic feet of gas per hour. What exact difficulties of operation we shall encounter in the use of a separate high-pressure street lighting system remains to be seen; but in Berlin, at any rate, they seem to have solved the working problems. It may be that American conditions will increase these difficulties, or the contrary may be true. Neither do we know what the expense for the maintenance of these lamps will prove to be on this side of the water. Of course, we must consider the extra investment necessary to supply the separate system; but this is not different from the case of the electric company where the street-lamps are operated from series circuits. Some of the manufacturers in Europe are working on a system by which air may be supplied under pressure in pipes and introduced at the burner—thus accomplishing the same purpose as with gas under pressure, but with less probable difficulties and expense. The whole question is admittedly in an experimental stage; and the next few years, no doubt, will see considerable work done along this line.

The practical difficulty in undertaking these experiments is to secure a long contract for a sufficiently large number of lamps to make the experiment worth while from a commercial point of view. We have taken the first step in an installation of five one-burner lamps in the town of Brookline, just outside Boston.

Another feature in connection with street lighting—especially regarding the future—is the use of automatic devices for lighting and extinguishing lamps. Under conditions in America, the cost of labour is high, amounting in some cases almost to as much as the cost of gas in the smaller units. A number of systems are in use in various parts of Europe, and also in some parts of this country, by which the hand labour is largely dispensed with, and the lamps automatically lighted and extinguished. These devices are of two kinds—the clockwork system and the pressure impulse system. In the former, a clock mounted on the lamp actuates mechanism in such a manner as to turn on the supply at the proper hour, which is then ignited by a pilot-flame. In the other system, the impulse of pressure is sent along the main from the works, and this actuates a valve by means of which the supply is turned on and lighted in a similar manner. The lamps, of course, cannot be left entirely without care; but this consists only in the cleaning and adjusting and renewing of mantles, and does not necessitate a daily visit to the lamp. These systems where installed abroad have been investigated; and the reports are satisfactory. Some installations have been made in this country with apparent success. There seems to be considerable hope for some assistance in this direction.

Conditions vary in each city; but at the usual rates for gas and electricity, there is no reason why gas should not continue to furnish the best and cheapest light for illumination of the streets.

Scottish Junior Gas Association (Western District).—A meeting of this Association will be held in the Technical College, Glasgow, next Saturday evening, at which Mr. V. M. Evans, of Glasgow, will read a paper on "High-Pressure Gas Distribution."

The Gas-Engine Industry in the Past Year.—According to an article in the Engineering Supplement to "The Times," the year 1909 will take its place in the annals of the gas-engine industry as one of steady development and of improving trade, rather than as one of exceptional activity. The volume of work had been falling since 1906; but, judging from the reports received, the corner has now been turned, and many works found the past year an increasingly busy one—some shops having even been fully employed.

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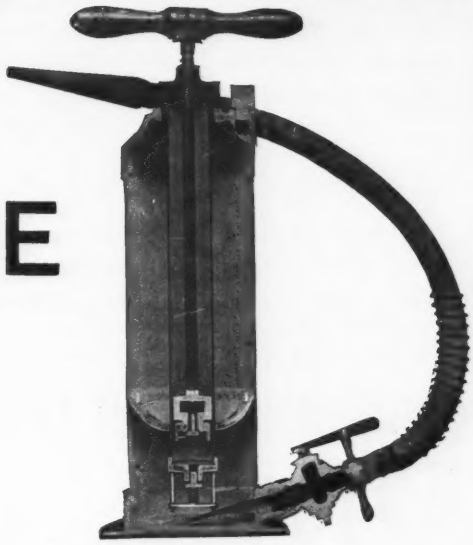

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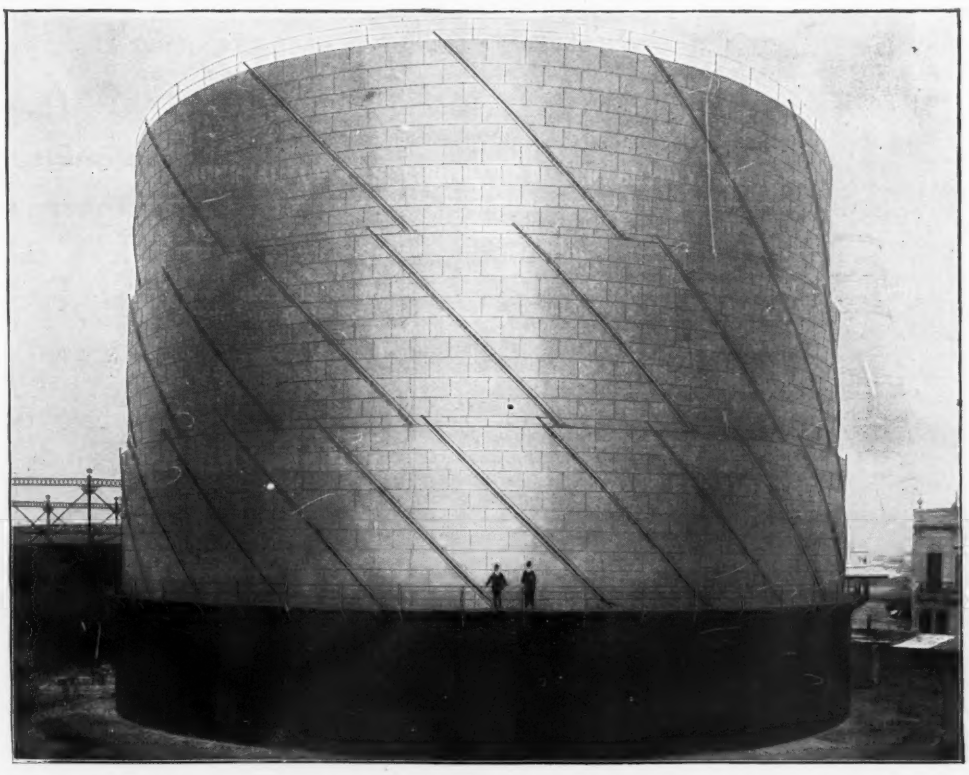

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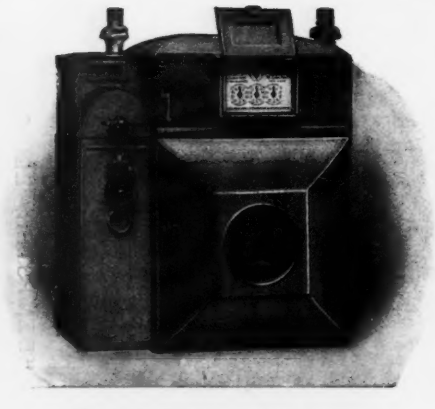

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EVAPORATION FROM WATER SURFACES.

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[Abstract of a Paper read before the Association of Water-Works Engineers.]

In introducing his subject, the author said he had recently had occasion to go somewhat closely into the question of the amount of evaporation from the surface of an impounding reservoir; and he found that the investigation entailed an immense expenditure of time and labour, as results of experiments and information on the subject were scattered through a great number of papers and articles. The late Mr. G. J. Symons, in "British Rainfall" 1889, stated that there were some 225 books and articles on the subject; and since that date there had been many others. The author had not been able to obtain access to the whole of them; but he had been through a very large number—something like 150 in all—and it had occurred to him that the collection of the more important data and the results in the form of a paper might be useful to the members of the Association, and possibly save some of them a good deal of labour.

Up to about 1885, when a standard iron tank 6 ft. by 6 ft. by 2 ft. deep, sunk in the ground, was installed by the late Mr. Symons at Camden Square, there were very few reliable records, either in this country or abroad; the chief exceptions being the following: Luke Howard's observations at Plaistow (1812 to 1815); Daniel's experiments near London; M. Vallé's experiments at Dijon (1846 to 1852); the long series commenced by the late Mr. James Leslie in 1853 at Glencorse, Peebles, and continued by Mr. Tait; the experiments of the late Mr. Greaves at Old Ford (1860 to 1873); Golding's records at Copenhagen; the Rev. Mr. Griffith's records at Strathfield Turgiss (1870 to 1883); Mr. Miller's record at Lowestoft (1878 to 1897); and Mr. Baldwin Latham's records at Croydon with a floating evaporator, which were begun in 1879 and have been continued up to the present time. The results obtained by various observers are so incongruous, and the opinions expressed so divergent, that it was impossible to summarize them; and the author felt that the only plan was to give the principal results and opinions as briefly as possible, and then endeavour to form some conclusions on the subject. Taking the data available as far as possible in their chronological order, the results of experiments and the expressions of opinion by authorities of which the author has found records are as follows.

In October, 1801, Dr. Dalton contributed a paper to the Literary and Philosophical Society at Manchester, in which he gives the results of a long series of experiments on the evaporation of water at various temperatures in dry air. He came to the conclusion that evaporation depends upon the difference of the force of vapour at the temperature of the surface of the water and the force of vapour in the air—the latter being determined from an observation of the dew-point; and that the same quantity is evaporated with the same evaporating force whatever be the temperature of the air. He also considered that with the same evaporative force a strong wind would double the effect produced in a still atmosphere, and that generally when the air is in motion the rate of evaporation increases with the velocity of the wind. Mr. Luke Howard's observations at Plaistow (Beardmore's "Manual of Hydrology," 1862, p. 296) gave the average evaporation for the three years as 21·13 inches; while Mr. Daniel's experiments showed that, taking the whole year as unity, the evaporation during the four winter months was 0·104; during the four months March to June, 0·434; and from June to October, 0·462. From 1839 to 1845, very careful experiments were made on the Burgundy Canal by M. Vallé. They were made at four places with large tanks, 8 ft. 2½ in. square by 16 inches deep, sunk in the ground; the observations being taken monthly, and the water in the tanks filled up to a depth of 10 inches on the first of each month. His experiments at Dijon were continued for a further seven years; and at La Roche for a further five years.

The results showed that the actual evaporation was less than one-half of what had been previously assumed in this district. At Copenhagen during eleven years (1849 to 1859), Mr. Golding found the mean evaporation to be 27·9 inches. In 1860 the late Mr. Thomas Hawksley said that near London evaporation from water was nearly 36 inches per annum; Mr. Bailey Denton found it to be 33 inches; and Mr. Braithwaite considered it was greatly influenced by the velocity of the wind. In 1861, Mr. Bailey Denton quoted Dr. Dalton's experiments as showing that the average evaporation from water surfaces in England was 44·43 inches; and Mr. Charnock found it to be 35 inches.

In 1869 the late Mr. Rogers Field and the late Mr. G. J. Symons read a paper at the British Association meeting, in which they referred to Professor Daniel's proposal of two methods of calculating evaporation from observations of the dew-point thermometer, but admitted that the error by this method might amount to 25 per cent. either in excess of or below the true evaporation. They also referred to Major Phillips and Lieutenant Haughton's experiments at St. Helena (and illustrated the apparatus used), and showed that the evaporation during 22 days in July and August, 1869, at Camden Square, as computed from the hydrometer, was 38 per cent. in excess of the true evaporation, as measured by Phillips pattern evaporator—*i.e.*, a small vessel immersed in water contained in a larger one—the computed evaporation being sometimes greater and sometimes less than the actual evaporation. Mr. Beverley found that the level of the water in the evaporator had an effect on the evaporation, and that this varied with the rapidity of the the movement caused by the wind. Mr. G. Dynes expressed the opinion that the only true way to measure evaporation is by means of an evaporator fixed in the midst of a large piece of water. In "British Rainfall" for the same year, Mr. Symons pointed out the inconsistency of almost all the then published records; and the following year he again discussed the question and described a large number of evaporators, most of which were worthless. He also made the important statement: "The key to the whole question will be found in one item—the temperature of the water."

Up to this time all the observers had endeavoured to trace some relation between evaporation and rainfall, and this fallacy is still persisted in to some extent; many subsequent records (including those of Mr. Fitzgerald in 1887) giving the evaporation as a percentage of the rainfall. Though the total evaporation and precipitation over the whole globe must be equal, it is perfectly certain that in any one particular place they bear no relation whatever to one another.

In 1876, the late Mr. Charles Greaves, in a paper on "Evaporation and Percolation" read before the Institution of Civil Engineers, gave results of his observations at the East London Water-Works, Lea Bridge, from 1860 to 1873, with a gauge, 3 feet square and 12 inches deep, floating in a flowing stream and read every day. The records show that the maximum monthly evaporation was 4·854 in July, 1868. In 1877, Mr. Harlow, in a paper submitted to the American Society of Civil Engineers, gave the annual evaporation at Ogdensburg (N.Y.) as 49·4 inches; at Syracuse, 50·2 inches; at Salem, 56 inches; and at Cambridge, 56 inches. These figures, the author believed, were only the records for a single year. In 1878, Mr. J. Brady, in a paper on the "Sandhurst Water Supply, Geelong, Australia," read before the Institution of Civil Engineers, gave the mean evaporation for the years 1848 to 1877 as 50 inches per annum. Mr. H. C. Russell (Government Astronomer for New South Wales) gave the mean evaporation at Sydney for nine years, 1871 to 1879, as 32·45 inches.

Early in 1885 the standard tank, the observations on which had been recorded by the Rev. C. H. Griffith, was removed from Strathfield Turgiss, near Basingstoke, to Camden Square; the observations at the former place having been made continuously for fourteen years (1870 to 1883). From 1885 to the present time, daily measurements from the tank have been made (by means of a hook gauge in a small compartment on the side of the tank) under the direction of the late Mr. G. J. Symons, and since his death under that of Dr. H. R. Mill. In 1886, Mr. Desmond Fitzgerald read a most important paper giving the results of very careful experiments, and also of observations on the evaporation from floating tanks in the middle of the Chestnut Hill reservoir of the Boston (U.S.A.) Water-Works, where the water was 20 feet deep; the area of the reservoir being 85 acres. Mr. Fitzgerald agrees with Dalton's original statement that "evaporation depends on the difference between the force of vapour at the water surface and that existing in the air;" but he does not consider that it bears any direct relation to the relative humidity of the air—the force of vapour depending entirely upon the temperature. He considers the dew-point a most important factor. As it varies the force of vapour varies; and, other things being equal, it is the difference between the temperature of the water and the

dew-point that determines evaporation. If the water be cooler than the dew-point, condensation will take place; if the dew-point is lower than that of the temperature of the surface of the water, evaporation takes place.

In "British Rainfall" for 1886 a comparison was made as to the results at Dijon (already referred to) which give the mean of 22·4 inches per annum, and those obtained in London; Mr. Greaves' experiments gave an average of 20·9 inches per annum. Mr. Symons expressed the opinion that, looking at the relative temperature and humidity of London and Burgundy, it seemed very reasonable that the evaporation in the latter should be about 10 per cent. more than in the former; but he thought at that time that the evaporation from a large water surface in this country would not exceed, if it reached, an average of 20 inches per annum. It was still considered, however, that evaporation depended largely on the wind. In 1889, however, Mr. Symons had changed his mind as to the effect of the wind. He concluded that the surface temperature of the water was the one important factor, and that the Strathfield Turgiss results represented what occurred in a lake or reservoir, and showed that practically all the other evaporators were unreliable. In 1890 he stated that for England the average of 18 inches shown by the standard tank was, in his opinion, a value to be adopted in preference to any other.

Mr. C. E. Peek, at Rousdon, Lyme Regis (Devon), found the evaporation in 1888 to be 16·82 inches, and the next year 17·25 inches. In 1890 the average evaporation at Lawrence, U.S.A., for three years, 1888 to 1890, is given as 29·16 inches in the report of the State Board of Health for Massachusetts. The notable point about these records is, that although the air temperature in the winter is very low, the evaporation is very considerable.

In 1892, Mr. William Matthews started a standard tank (similar to that at Camden Square) at Otterbourne, near Winchester; and other tanks have since been installed at Kennick, Devon, by Mr. W. Ingham; Downholland, Lancashire, by Mr. J. Baxendell; at the Ardsley reservoir, Wakefield, by Mr. Clemesha Smith; at Heaton, Bolton, by the late Mr. R. H. Swindlehurst; at Stanley Grange, Wakefield, by Mr. H. Stanley Haworth; at Revesby, near Lincoln, by Mr. J. Shaw; at the Talla Water-Works, Peebles, by Mr. W. A. Tait; and at Isfield, Sussex, by Major H. King.

In "British Rainfall" for 1903, Dr. Mill pointed out that the individual observations vary so much that he was unable to draw any definite conclusions as to the distribution of the amount or the rate of evaporation; and he expressed the desire to see experiments carried out on the effect of different exposures to the sun and wind on evaporation from two precisely similar tanks at the same place. In the following year, which completed the twenty years' record at Camden Square, Dr. Mill made the very significant statement that, generally speaking, the monthly results for the whole period appeared to show some relation to the amount of sunshine; and, further, that the excess of rain relatively to the average in 1903 accompanied evaporation similar to that in 1904, when the rain was generally below the average. This would appear to dispose of the inverse relationship sometimes supposed to exist between the amount of rainfall and evaporation.

In 1905, Mr. Rafter (*vide* Bulletin, No. 85, 1905, p. 134) referred to Professor Cleveland Abbé's statement of relations of evaporation as established by Professor Thos. Tate. These conclusions are that, other things being the same—

(*a*) The rate of evaporation is nearly proportional to the difference of the temperatures indicated by the wet and dry bulb thermometers.

(*b*) The increase of evaporation due to air in motion is nearly proportional to the increased velocity of the wind.

(*c*) The evaporation is nearly inversely proportional to the pressure of the atmosphere.

(*g*) The rate of evaporation from a horizontal surface facing upwards is very much affected by its elevation above the ground.

(*h*) The rate of evaporation is affected by the radiation of surrounding bodies.

Mr. Rafter considered that the velocity of the wind must have a very material effect.

In the same year, Dr. Mill, in "British Rainfall," has an interesting note on the relation of evaporation from a water surface to other meteorological phenomena which gives a comparison of the evaporation with the temperature in air and soil, duration of sunshine and rainfall, relative humidity, and amount of rain. The curve of evaporation closely followed those of the soil and air temperatures during winter, early spring, and late autumn. During summer, including the late spring and early autumn, the evaporation ceased to follow the mean temperature curve, and during these periods the black bulb thermometer and still more the duration of sunshine and rainfall seem to have had the greatest effect on evaporation. On one occasion only the influence of wind seems to have accelerated evaporation. He then discusses an instructive diagram given, and concludes: "Too much stress must not be laid upon the conditions for one year, but, as far as it goes, this year shows that when evaporation was below the average it followed the mean temperature; when it was above, it followed the sunshine and black bulb temperature, and the wind appeared to have but little effect upon it."

In 1906, Dr. Mill published in "British Rainfall" another diagram of the observations at Camden Square, and pointed out in his notes on evaporation that, as in the previous year, the main factors appear to be the mean temperature of the air in the winter and the duration of sunshine in summer. In 1907 a new form of evaporometer—the Wilson "Radio-Integrator," was described and illustrated in "British Rainfall." This instrument appears to the author to be based on the right principles; but it does not seem to be sufficiently sensitive to the reduced evaporating power of the sun during the winter months. In 1908 from the diagram of results at Camden Square, Dr. Mill considered that the radio-integrator curve showed an unmistakable relationship to the evaporation curve during the summer; and he thought the instrument offered the best means of estimating evaporation in the absence of a tank. In referring to the wind, he stated that the effect was far less pronounced than that of sunshine and temperature.

In a large table the author gives the mean monthly and yearly evaporation in inches for all the places where standard tanks have been established, and for some others where the records have been carefully kept with smaller tanks, and can probably be relied upon. The records for Port Elizabeth, Lawrence (Mass.), and Boston (U.S.A.), and some Australian stations, are inserted for comparison. He concludes his paper with the following observations.

In the whole of the records which the author has been through, he has not observed a single instance of the maximum annual evaporation occurring in the same year in which the minimum rainfall occurred, which is a fortunate thing for water-works engineers; but, of course, it does not follow that because such a coincidence never has occurred, that it never will occur. What water-works engineers want is to be able to estimate with some degree of accuracy what evaporation is likely to occur, in the absence of reliable records of actual evaporation for a long period such as we now have for several places. But it is not easy to see how this is to be done. As already stated, the radio-integrator seems a step in the right direction. From a careful consideration of the existing data, it appears to the author that the intensity and duration of the solar radiation are the determining factors. It also appears to be established that the barometric pressure has so small an effect as to be negligible, and that although the wind has some small effect, it is so small as to be practically inappreciable in comparison with the effects of temperature.

Proceeding on this basis, the author has endeavoured to find some method by which the evaporation can be calculated from the records of intensity and duration of sunshine. He has obtained such records for various places, but, unfortunately the records of both sets of observations are not available at the same place (and are therefore useless for this purpose), except at Camden Square. He has been able to obtain records for the last four years through the kindness of Dr. Mill. This is, of course, only a short period; but, bearing this in mind, the results of the calculations from these data are, he ventures to think, extremely satisfactory.

Taking the average maximum sun temperature, and multiplying it by the duration of sunshine and by a factor, the figures agree very nearly with the evaporation observed in the standard tank. The factor based on the records for these four years is 0·0001254. Using the same formula for each of the four years, the results are true within a very small percentage. Thus for 1905 the difference between the calculated and observed evaporation is only — 0·7 per cent.;

for 1906 it is only — 0·8 per cent.; for 1907 it is — 3·9 per cent.; and for 1908 it is + 6·8 per cent.

The formula is—

$$E = M \times D \times 0{\cdot}0001254.$$

E being the evaporation in inches.

M „ „ mean maximum sun temperature in degrees Fahr.

D „ „ duration of sunshine in hours.

Although this formula gives the above results for the whole year, if it is applied to the individual months, it gives a result rather too high for the winter months, and rather too low for the summer months. Taking the summer records for the four years at Camden Square to calculate the evaporation during the six summer months, April to September inclusive, the equation becomes—

$$E \quad \frac{M \times D - 3500.}{6000}$$

The constant 3500 and the divisor 6000 are empirical figures, and may possibly require some alteration when the observations for a long series of years are available.

The following table shows the summary of the records for each year and for the average of the four years, and also the evaporation calculated from this equation. It will be seen that the calculated evaporation agrees very nearly with that observed.

—	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Year.
Duration of sunshine 1905	38·7	68·1	86·0	91·3	222·2	157·6	214·8	148·4	104·1	93·9	33·5	12·4	—
Mean maximum sun temperature ,,	53·4	68·4	83·4	89·3	112·0	109·6	121 7	114·5	100·1	79·6	59·6	49·8	—
D × M . . . . . ,,	2,065	4,660	7,160	8,140	24,900	17,280	26,000	16,990	10,420	7,470	1,997	618	—
Evaporation in inches (actual) . ,,	·17	·35	·65	1·14	3·19	2 49	3·65	2·23	1·24	·78	·09	·16	16·14
Evaporation in inches (calculated) ,,	—	—	·61	·77	3·56	2·30	3·75	2·25	1·15	·66	—	—	—

—	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Year.
Duration of sunshine 1906	43·3	67·9	99·4	192·9	124·7	216·1	235·9	196·9	154·1	79·8	29·9	37·2	—
Mean maximum sun temperature ,,	60·3	64·6	79·6	99·4	102·2	114·4	120·6	118·5	106·9	86·0	61·6	51·2	—
D × M . . . . . ,,	2,610	4,380	7,910	19,160	12,760	24,750	28,410	23,300	16,480	6,860	1,841	1,904	—
Evaporation in inches (actual) . ,,	·06	·21	·73	1·90	1·9	3·53	3·65	3·46	2·38	·78	·27	·16	19·03
Evaporation in inches (calculated) ,,	—	—	·73	2·61	1·54	3·54	4·15	3·30	2·16	·56	—	—	—

—	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Year.
Duration of sunshine . . . 1907	40·1	53·7	151·4	104·2	137·0	146·5	162·6	149·7	143·9	73·9	30·6	23·4	—
Mean maximum sun temperature ,,	53·0	60·5	78·4	91·1	102·5	109·9	109·5	108·8	101 5	67·4	60·5	51·9	—
D × M . . . . . ,,	2,122	3,250	11,880	9,490	14,050	16,100	17,800	16,280	14,600	4,975	1,850	1,215	—
Evaporation in inches (actual) . ,,	·21	·38	1·02	1·27	1·93	2·47	2·65	2·24	1·72	·49	·27	·19	14·84
Evaporation in inches (calculated) ,,	—	—	1·39	·60	1·76	2·10	2·38	2·13	1·85	·25	—	—	—

—	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Year.
Duration of sunshine . . . 1908	32·5	53·1	97·7	141·8	173·7	240·0	161·5	179·3	129·3	84·8	48·2	14·0	—
Mean maximum sun temperature ,,	50·1	66·8	76·0	85·8	108·7	115·6	111·1	109·5	99·6	83·7	65·9	47·2	—
D × M . . . . . ,,	1,629	3,550	7,420	12,160	18,870	27,740	17,960	19,640	12,890	7,100	3,177	660	—
Evaporation in inches (actual). ,,	·05	·27	·56	1·32	2·23	3·77	2·75	2·47	1 25	·48	·29	·14	15·58
Evaporation in inches (calculated) ,,	—	—	·65	1·44	2 56	4·04	2·41	2·69	1·56	·60	—	—	—

Mean.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Year.
Duration of sunshine	38·6	60·7	108·6	132·6	164·4	190·1	193·7	169·3	132·8	83·1	35·6	21·7	—
Mean maximum sun temperature .	54·1	65·1	79·3	91·4	106·3	112·4	115·7	113·0	102·1	79·1	61·9	49·8	—
D × M	2,088	3,952	8,612	12,110	17,480	21,380	22,400	19,131	13,560	6,573	2,203	1,080	—
Evaporation in inches (actual) . .	·12	·30	·74	1 41	2·31	3·07	3·17	2·60	1·65	·63	·23	·16	16·39
Evaporation in inches (calculated) .	—	—	·85	1·43	2 33	2·98	3·15	2·60	1·67	·51	—	—	—

The factors in either of the equations will probably only be true for England and places having the same latitude and variations of climate, and it will be extremely interesting if any members of the Association have access to records at other places, to see what alterations in the factors are necessary for different latitudes. Calculations based on the results from tanks will be on the safe side, as although it is not very definitely supported by figures, the impression left on the author's mind by a study of the subject is that the tank records give a result in excess of the actual evaporation from reservoirs, provided the latter are kept reasonably full. The only definite figure supporting this impression is that given by Mr. Desmond Fitzgerald, where in the large tank, 10 feet diameter by 10 feet deep, floated in the middle of a large body of water (in the Chestnut reservoir at Boston, U.S.A.), it was found that the temperature of the water in the tank did not agree with that of the water of the reservoir; the difference on one occasion being as much as 10° Fahr. This supports the author's conclusion that the radiant heat has a far greater effect upon evaporation than heat transmitted by contact.

Discussion.

Mr. William Watts (a Past-President) wrote: The loss by evaporation from the surface of a large reservoir is slightly greater than that from the experimental tanks referred to by the author, in consequence of the crest of the waves breaking up and toppling over into the trough of each wavelet. Although dew cannot be measured in rain-gauges, it has a potential value in its effect on the amount of evaporation from the surface of still water. Atmospheric vapour in supplying dew provides some water not accounted for in the rain-gauges and not revealed by the phenomena of evaporation. Although it may not be recoverable in a measurable quantity, its effects must be felt on large water-sheds, such as those in the Pennine valleys. No attempts have, however, been made by water-works engineers to scientifically measure it. All available drainage areas in the country should be measured; and their rates of rainfall known, not only for the information of the county councils, but for the benefit of corporations requiring water.

Mr. C. Clemesha Smith (Wakefield) said the whole point of the paper rested in the discovery of some means of ascertaining the evaporation from the solar radiation and the duration of the sunshine. Dr. Mill, in his "British Rainfall, 1907-8," referred to the Wilson radio-integrator. This instrument utilized the same two factors that Mr. Lowcock had embodied in his formula. It utilized solar radiation and the duration of sunshine. Dr. Mill stated that the curve of wind velocity appeared to have very little relation to that of evaporation; but he pointed out in one case, where he had a difference between the results from the Wilson radio-integrator and the results from the tanks, that the radio-integrator was screened from the wind, whereas the tank was not, which did not square with his remark that the wind had little relation to evaporation. Was it not possible that, if the two had been equally exposed to air movement the results might have been more accordant?

The President said it would be interesting if Mr. Smith or Mr. Lowcock would explain how these tanks were fixed in the water; and how the wind affected them with the water on the outside. Did the wind blow water into them or out of them in exposed places? Wind would blow up waves on large sheets of water.

Mr. SMITH said in his case the tanks were 6 feet square and 2 feet deep; and they were made of galvanized iron, and were sunk into the ground. All the standard tanks were in the ground some distance from the water. If they were put into water, there was the difficulty of waves breaking over the side, and a large amount of water getting into them, and so vitiating the value of the observations. The top of the tank was some 2 to 3 inches above the surface of the ground; and they kept the level of the water as near as possible to the level of the ground. If, owing to excess of rainfall over evaporation, the level of the water rose, they took a measured 1 inch or 2 inches out of the tank; and if evaporation took it away more rapidly than the rainfall was replacing it, they put a measured inch into the tank.

Mr. EDWARD SANDEMAN (Derwent Valley Water Board) said a few years ago he had an evaporation tank on Dartmoor of which he kept a record, and recently he had had one in Derbyshire. The results on Dartmoor, at an elevation of 700 feet, showed under 20 inches of evaporation; and those in North Derbyshire, at an elevation of 750 feet, about 11 inches. The point he should like to put to the author was in what way he proposed to use the figures. He did not himself see there was much scope for their use by water-works engineers. If they were to be used to ascertain the loss from reservoir surfaces, it did not appear that the loss was likely to be more than 1 or 2 per cent. of the quantity of water supplied per annum, which was so small an amount as to be practically negligible in formulating a scheme of water supply.

Dr. HERBERT LAPWORTH (Derwent Valley Water-Works) said the first thing that struck one on looking at the formula the author employed for the annual evaporation was the use of the term M—that was, the mean maximum sun temperature in degrees Fahrenheit. As the formula stood, it would mean that, so long as there was sunshine of any duration with a maximum temperature well below freezing-point, there would be some evaporation. This did not seem quite natural. It would look, therefore, as if the basis of his formula was not quite correct; and in dealing with mathematical points of this sort, unless one got the basis correct, one landed oneself into all sorts of errors by trying to harmonize the different factors and the experimental results. The author apparently had felt a difficulty because when he tried to apply the first formula month by month, he found, as he said, the results were too high in the winter and too low in the summer. As a rough check, he (Dr. Lapworth) had worked out the first year on the sheet—that was 1905—and the results seemed to be quite satisfactory. In spite of all this, however, it appeared to him that in certain other places—for instance, in exposed situations—a formula of this kind, while it might be a rough guide, should not be depended upon, for the simple reason that, he believed, the wind, particularly in exposed situations, must have an effect on the evaporation. Why he said this was for the same reason that Mr. Sandeman had mentioned. He had been testing some filter-beds, having to take into account the evaporation. The only particulars he could get were from an experimental evaporation tank 5 miles away. The results seemed to show the evaporation at the two places to be far from identical. So that it appeared to him that evaporation might vary enormously within quite a few miles. To verify this, he looked into some of the American journals; and he found that there were many cases where they had monthly evaporation three and even four times, and annual evaporation over twice, as much in one place as in another, in the same State, and fairly close together. Therefore, he thought it exceedingly unlikely that a formula for the Camden Square tank could be applied to other places, unless one took into account several other factors—such as the velocity of the wind and the moisture of the air. He should like the author to describe the Camden Square tank, and let them know to what extent it was exposed—whether the wind could reach the water surface, and whether the tank was sheltered by houses or other screens.

Mr. S. C. CHAPMAN (Torquay) said there were one or two points in connection with the question of evaporation that were sometimes lost sight of. In the first place, there was the direct influence not only on reservoirs, but on streams as well. The flow of streams varied between day and night to a considerable extent—to an extent that he did not think was appreciated by the majority of engineers. He had been watching some stream-gauges for a long time; and he observed that, in the summer months, there was a distinct difference between the flow in the day and night. There was just another point. He likewise noticed that evaporation followed almost uniformly with the numbers of hours of sunshine. By way of curiosity, he had worked out the amount of evaporation per hour of sunshine throughout three years. He took a wet year, a medium year, and then a dry year. The wet year was 1903 (when they had 52 inches of rain, which was practically the maximum), and 1906 and 1908; and he found the mean of the three years was 0·01103 inch of evaporation per hour of sunshine taken throughout the year. The years were as follows: 1903, 0·011 inch; 1906, 0·0118 inch; 1908, 0·013 inch—making the mean, as he said, 0·01103 inch per hour of sunshine.

Mr. H. E. STILGOE (City Engineer, Birmingham) said to his mind, the great object of this paper, or perhaps the great use of it, had been to draw the members' attention to the large divergence of opinion and of obtained results. Dr. Lapworth said the formula was only a rough guide. This might be so; the author acknowledged it. So were all the results that had been obtained merely rough guides, because they varied so much. If they took Mr. Baldwin Latham's figures of his gaugings—the gauge in which he had a copper vessel of 1 foot diameter floating in a vessel 4 feet diameter, with 3 feet of water—his yearly average for a period of 30 years was 18·137 inches; whereas in another form of gauge—4 feet square, and standing entirely in the open on an iron pedestal, completely exposed to the air—he got 33·85 inches. Of course, it was obvious the latter form of gauge would probably not give such accurate results as a tank 6 feet square and about 2 feet deep, buried and the top level with the surface of the ground, the water in which was filled up as it evaporated and the gaugings were taken. Now whether the amount of evaporation was much or little, whether it mattered was quite another thing. He said that the use of these observations and these gaugings, and so forth, was that they turned the mind in a particular line, and that they taught them to observe things and to record them, and to get a knowledge of meteorological conditions which might otherwise be passed over as useless.

Mr. F. W. HODSON (Loughborough) said the figures in the paper only applied to water surfaces; and he, like some of the other members, looked first to see what was their actual effect, because, as they all knew, evaporation was the greatest factor which an engineer of overground or underground water-works had to take into account. He valued all these figures, because they were a distinct advance, and would no doubt ultimately assist in the solution of a greater problem; but he did not think the figures as they stood relating to water surfaces only were of such importance as those which referred to watershed areas. Applying the average figure of the tables—namely, about 18 inches—to two reservoirs almost similar in watershed area, rainfall, total capacity, and total daily supply (which amounted to 2 million gallons), he found a result in one case of 4·6 per cent. of loss throughout the year, provided the reservoir was kept quite full. Of course, a reservoir in normal operation would sink in level during the summer time when evaporation was at its highest, and evaporation would only act on the smaller surface area. Therefore the figure became reduced to probably something like 3 per cent. In the second reservoir—a shallow reservoir in proportion to its area—if kept full throughout the year, the loss amounted to rather over 10 per cent., subject also to some reduction in working. This was a serious amount, though it did not compare with the loss they got throughout the whole watershed area, which amounted to considerably over 60 per cent. in both cases.

The PRESIDENT: Are you giving the percentage on the total capacity of the reservoir, or the water got out of the reservoir?

Mr. HODSON replied on the percentage of the daily supply available out of the reservoir. He should also like to confirm the observations Mr. Chapman had made, as to the variation found in recording the flow of streams between day and night, which he had observed for many years. He should like to give the figures from a stream which was measured regularly for ten years. He found that, during the three months, December, January, and February, the rainfall was about 25½ per cent. of the mean rainfall during the same period of ten years. The quantity which ran off during those months was 51½ per cent. of the total annual mean flow. During the three other winter months—October, November, and March—with a rainfall of 24 per cent. of the whole year, the flow-off was 24½ per cent. of the mean, which left them with the six summer months, in which they

had 51½ per cent. of the rainfall, yielding only 24 per cent. of the gross supply over the whole ten years. These figures showed the importance of the effect of evaporation; and it was the relationship between them and the evaporation from a water surface which was capable of definite measurement which required elucidation.

Mr. William Matthews (Westminster) said perhaps he might say a word or two, as he was responsible for one of the observations that went on for sixteen years—the one at Otterbourne, which was started at the special request of the late Mr. Symons, and for a particular reason. The conclusion he (Mr. Matthews) came to long before was that evaporation depended upon the component of the temperature and the prevalent wind. The temperature alone was not sufficient to account for the variations; but the wind had a great deal to do with it. The subject wanted a good deal more study; and he did not think anything could be settled until they had had much larger experiments than they had at present. One thing the author had omitted. They might hope he would put it into his paper—that was, the height of the gauges above sea-level. Mr. Symons considered this was an important point; and he (Mr. Matthews) believed that, in the Rainfall Organization books, Mr. Lowcock would find the elevations of most of the gauges referred to in his paper.

Mr. Lowcock, in reply, said he was very gratified that the paper had produced such a good discussion; and that it had brought out, exactly as he hoped it would do, the results of observations that other members had been able to make, and which he had not been able to carry out himself. Mr. Smith and other members referred to the wind. He could not in the paper give the whole history of what had been done in connection with wind experiments. But this question of the wind had cropped up from time to time, and had been a great subject of discussion. At Camden Square, in order to test the matter, Dr. Mill had a wind-recording apparatus fixed by the side of the tank, and the results of the experiments he (Mr. Lowcock) had thus referred to in the paper: "The curve of wind velocity appears to have very little relation to that of evaporation; contrary to the hypothesis we set out to test." If members would look up the references to the matter, they would find that a good many experiments were made on wind. Mr. Sandeman had asked what was an extremely pertinent question: "After all, what was the good of it all?" He (Mr. Lowcock) thought this had been partly answered by Mr. Hodson in the figures he had given. The evaporation from water surfaces had been of great importance both to him (Mr. Lowcock) and his clients. That was why he started on the investigation. As he mentioned at the beginning of the paper, there was no doubt, in his mind at any rate, that evaporation from water surfaces must bear a relation to that from the area of the gathering-ground. If it did, then this sort of investigation was one step in the chain which would eventually, he hoped, enable them and their successors to do something even better than they did at present, in a sort of haphazard way, in arriving at the available quantity of water gathering-grounds could be relied upon to yield. There was another direction in which records of the kind would be extremely useful. The tendency at the present time was to put up big reservoirs, as for London, in which to store the raw river water for at least thirty days. The loss from these shallow reservoirs through evaporation was something considerable. All the water had to be pumped, and it was also a matter of considerable importance to know what the evaporation was, in deciding what the capacity of the reservoirs should be, as they would have to store a large proportion of a supply amounting to something like 200 million gallons per day. In this case, therefore, it became a matter of double importance.

GAS-STOVES AND AIR PURIFICATION.

Important Experiments in Glasgow.

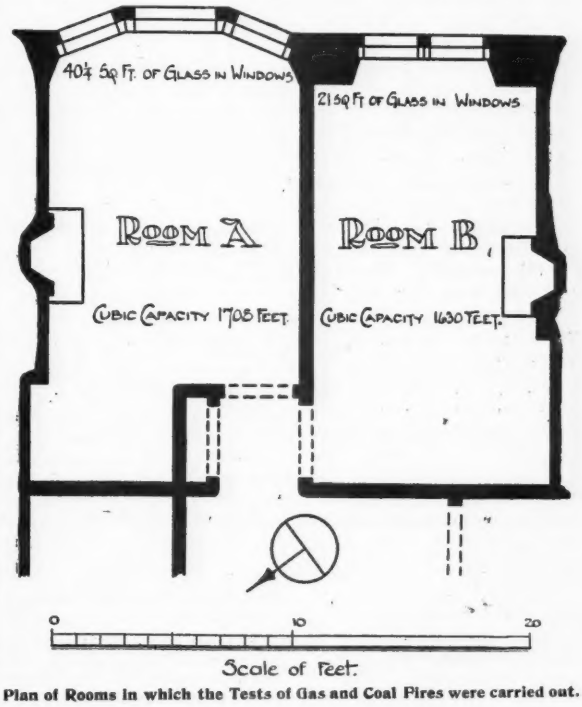
The following report by the Corporation Chemist (Mr. F. W. Harris), the Sanitary Inspector (Mr. Peter Fyfe), and the Engineer of the Gas Department (Mr. Alex. Wilson), on the effect on the atmosphere of a more general use of gas-stoves in dwelling-houses has been submitted to the Corporation of Glasgow.

In obedience to the remit to us to report upon the effect which a more general adoption of gas-firing in dwellings and occupied premises in the city would have on the city's atmosphere, we have the honour to lay before you the following facts and considerations as the result of experiments we have made in firing with gas and coal in dwelling-houses. We were quite aware that experimental evidence was unnecessary to enable the educated to realize the great hygienic advantages to our atmosphere of burning gaseous fuel instead of coal; but we feel that, before the citizens generally will voluntarily adopt gas as a domestic fuel, they must be convinced of three things—(1) that the heating efficiency of a gas-fire is equal to, if not better than, that of a coal-fire; (2) that hygienically a gas-fire compares favourably with a coal-fire; and (3) that the relative costs of gas and coal for heating and cooking purposes are not such as to make the former uneconomical by comparison.

Our experiments were therefore directed with these considerations in view; and we determined to make them under conditions which would appeal to the general community, by securing the undisturbed tenancy, during six months, of two dwelling houses of equal dimensions in all respects, and identical as to situation. A plan of each house is shown, except the kitchen, which in each case lies behind. Both of them were therefore ordinary houses of two rooms and a kitchen, on the same flat, and, with the exception that they were unfurnished, similar in size to the great mass of such dwellings in the city. The four rooms in the two houses were labelled A, B, C, and D; A and B in the one house being in all respects the same as C and D in the other. In A and B the gas-fire experiments were carried on simultaneously with the coal-fire experiments in C and D. In each case the kitchens of the respective houses were utilized as temporary laboratories.

Firstly, we give a record of our experiments and their results as to the comparative heating efficiency of gas and coal fires. The experimental determination of the comparative heating efficiency of gas and coal fires is a complex problem. It is not solely a question of how many degrees the atmosphere of a room has been raised by the consumption of a definite quantity of gas or coal; the mode by which the heat transference has taken place is equally important, if not more so. Heat is diffused by three different processes—by conduction, convection, and radiation. For the purposes of this report, the proportion of heat diffused from a fire into a room by conduction alone can be ignored, as it is relatively a negligible quantity. This leaves for our consideration convected and radiant heat.

It is common knowledge that, when air is heated, it becomes lighter through volume expansion, and consequently rises; its place being taken by air of a lower temperature and of greater density. This process is a continuous one so long as the source



Plan of Rooms in which the Tests of Gas and Coal Fires were carried out.

of heat endures. Currents of air are in this way set in motion; the heated moving air eventually parting with its heat to the ceiling and walls of the room. This mode of heat diffusion is termed "convection."

In a room heated entirely by convected heat, the temperature

of the air must necessarily be higher than that of the walls or floor—a condition which is undesirable, as, apart altogether from the personal discomfort experienced in breathing warm air, there are other weighty objections. Radiant heat, on the other hand, is diffused with entirely opposite effects. It passes or radiates through air without warming it, and is absorbed by the walls and floor of the room, which again slowly part with their heat to the air in contact with them, so that the walls and other solid bodies in the room are at a higher temperature than the air. Under such conditions, one experiences a sense of warmth without breathing unduly heated or dried air. Hygienically considered, radiant heat is the ideal mode of heat diffusion. Consequently, the radiation efficiency of a gas or coal fire must either commend or condemn it as a suitable source of heat for domestic purposes. We therefore devoted very particular attention to this part of the subject.

Testing Radiation Efficiency.

Radiant heat, like light, is diffused from all bodies in straight lines and in all directions; the intensity of the radiation emitted from any given point being the same at equal distances from that point, and at unequal distances inversely as the square of the distance.

Different methods have from time to time been proposed for determining radiant heat. In 1907, a paper was read before the Institution of Gas Engineers by Mr. J. H. Brearley, of Longwood, in which he described a method for testing radiation efficiency, which method is not only far more sensitive, but yields more accurate comparative results than the older ones. The apparatus we employed was a thermopile, consisting of fine iron and constantin wires; the instrument being connected with a single-pivot moving coil galvanometer. The rays of the radiant heat striking on the thermopile set up an electric current, which passes through the connecting wires to the galvanometer, causing the needle to be deflected in proportion to the intensity of the rays. A weak point of this method, as with all other suggested methods, is that it is only comparative; the reading of the deflection of the galvanometer needle conveying no idea as to the intensity of the radiant rays expressed in any form of heat units. It only serves to indicate the radiation efficiency of one fire as compared with another.

Considerable time was spent by us in an endeavour to find a suitable method by which the readings could be calculated into heat units given off, but without success. Naturally, the test being only a comparative one, a definite system was necessary in working with the thermopile and galvanometer, in order that the readings should be made under exactly similar conditions. We made a semicircle, 3 feet in diameter, on the floor, with the middle fret of the fire as centre. Galvanometer readings were taken with the thermopile on this semicircle, at a height of 1 foot, and at a distance of 1 foot apart, beginning from the left. In this way, seven readings were taken at this height; and these readings were repeated at heights of 2, 3, and 4 feet. It must be understood that in each case, before the galvanometer readings in the different positions of the half circle were recorded, it was determined that the intensity of the radiation emitted by the different gas-fires was practically constant.

In experimenting with different gas-fires over a lengthy period of time, the calorific value of the gas varied slightly, as also did the pressure and the consumption. Hence it became necessary, in order to make the figures expressing the radiation efficiency strictly comparable, to calculate the same to a common standard. The standard adopted, and the method of calculating the same, are fully explained in Appendix I.

The radiation efficiency of the gas-fires tested, as indicated by the galvanometer readings taken at a height of 1 foot (the position of maximum intensity), and calculated to a standard of 100 cubic feet consumption of gas of a calorific power of 600 B.Th.U., is expressed as follows.

Comparative Radiation Efficiency.

No. 1 Gas-fire	86	No. 6a Gas-fire	135
,, 2 ,,	81	,, 6b ,,	82
,, 3 ,,	70	,, 7a ,,	120
,, 4 ,,	91	,, 7b ,,	91
,, 5 ,,	90		

Note.—Nos. 6a and 6b represent the results of observations of the same fire burning different consumptions of gas. In the case of 7b, four of the centre burners were turned off.

The great advantage of a coal-fire, from the point of view of comfort, is that the heat therefrom imparted to a room is diffused in the form of radiant heat. The question naturally follows—How do the above figures, expressing the comparative radiation efficiency of various gas-fires, compare with the figures obtained under similar conditions for coal-fires? As previously stated, a reliable comparison of the radiation efficiency of gas-fires was only rendered possible from the fact that the intensity of radiation became practically constant after a certain time. Experiments on similar lines to ascertain the radiation efficiency of coal-fires speedily demonstrated that with coal-fires the case was quite the reverse. We found the galvanometer readings to fluctuate so rapidly and so widely that any attempt to record a series of readings with the object of calculating them to a standard of definite coal consumption and calorific value was rendered futile. In fact, such a record would, in our opinion, be not only worthless, but actually misleading. A decision on the comparative heating efficiency of gas and coal depends, as we have explained, so much on the comparative radiation efficiency of these fuels, when burned under ordinary conditions, that for the purpose of this report such a comparison becomes essential.

After careful consideration, we decided to experiment on the following lines: A gas-fire was ignited and a coal-fire was kindled simultaneously in two different rooms, both identical in regard to situation and structural details. Galvanometer readings were taken every ten minutes throughout a period of six hours, from 10 a.m. to 4 p.m. The thermopile was placed at the point of maximum intensity on the semicircle mentioned, which point we found to be the centre, at a height of 1 foot, both for gas and coal fires. The coal combustion was regulated according to the usual domestic practice—the fire gradually developing into a bright, clear combustion, then allowed to burn itself somewhat low before replenishing with a fresh supply of coal.

Experiments were made on two days with different gas-fires. Gas-fire No. 4 consumed 29·7 cubic feet per hour at a pressure of 16-10ths; while the consumption of gas-fire No. 6 was higher—namely, 33 cubic feet per hour at a pressure of 16-10ths. The results are graphically illustrated by curves in Appendix II. These curves bring out very clearly that the radiant efficiency of the two gas-fires, after a relatively short interval of time, becomes remarkably constant. On the other hand, the radiant efficiency of a coal-fire is very irregular, rising rapidly to the point of brightest combustion, and then falling equally as rapidly until the fire is replenished with a further supply of coal and the effective combustion renewed. Another point, and a very important one from a practical point of view, is shown by these curves—namely, the rapidity with which gas-fires in contrast with coal-fires develop their radiation efficiency.

In the case of the first experiment with gas-fire No. 4, the galvanometer indicated at the first observation taken (ten minutes after igniting the fire) a reading of 22; a similar reading for No. 6 gas-fire being 33. The development of the radiation efficiency of the coal-fire was much lower in the first experiment. A galvanometer reading of 22 was not obtained until after one hour's combustion, although from gas-fire No. 4 this reading was obtained in ten minutes. Similarly, to equal the first ten minutes' galvanometer reading obtained from gas-fire No. 6, the coal-fire required 44 to 45 minutes.

If we debar from the comparison gas-fire No. 6, on account of its comparatively high radiation efficiency and gas consumption, and limit our consideration to the results obtained with gas-fire No. 4, whose comparative radiation efficiency was 91, we notice, firstly, that the intensity of radiant heat emitted from a gas-fire is very regular, while that from a coal-fire is subject to extreme and rapid fluctuations; secondly, that the radiating powers of a gas-fire are much more speedily developed than of a coal-fire.

It is obvious that, given a modern, well-constructed gas-fire, fitted with gas and air regulators, intelligently fixed and used, the radiation efficiency becomes a definite asset; whereas the corresponding efficiency of a coal-fire, being dependent upon innumerable conditions, cannot be designated otherwise than as an indefinite quantity. Another advantage that a gas-fire possesses over a coal-fire is that its radiation efficiency is, to a certain extent, under control, which is certainly not the case with a coal-fire.

Heat Diffused by Convection.

Convection has been defined as the motion of a hot body, itself carrying its heat with it; the hot body, as already explained, being in this case the air which receives a portion of the heat generated by the combustion of coal or gas. It is obvious that the air in the near vicinity of the fireplace must necessarily receive the greatest stimulus; hence the upward current of air is in this position the most pronounced. In order to render this current of air amenable to measurement, we had a hood constructed, similar to that devised by Mr. J. H. Brearley in his experiments on convected heat. A sketch of the hood, as fixed in position for testing purposes, is given in Appendix III.

Careful experiments were made in order to ascertain whether the opening in front permitted an uninterrupted passage for the radiant heat. This was found to be the case. The practice was followed as in testing for radiated heat—no observations being recorded until each gas-fire had reached its normal heating point. In Appendix IV. are tabulated the observations made, and the result deduced therefrom. In the notes accompanying the table, the method of calculation is also given. The main point for consideration here is the percentage of total heat generated by the combustion of gas in the different gas-fires, which was transmitted to the room in the form of convected heat (see Columns 11 and 12). The following percentages were obtained:—

	Percentage of Total Heat Given Off as Convected Heat.
Fire No. 1	7
,, ,, 2	19
,, ,, 3	13
,, ,, 4	23
,, ,, 5	10
,, ,, 6	16
,, ,, 7	29

In addition, an experiment was made with a ball-fuel fire—the ball fuel fitted into an ordinary fire-grate furnished with bunsen burners. The result obtained for this fire was 6 per cent.

Similar experiments were made with a coal-fire under identical conditions (see Appendix V.). However, owing to considerable fluctuations in the anemometer readings taken at the top of the hood, we thought it was expedient to take frequent observations

throughout the day from 10 a.m. to 4.30 p.m., and average the results. The tabulated results for the convected heat from a coal-fire show that 2·3 per cent. of the total heat generated from the combustion of coal in an ordinary domestic fire is imparted to the room in the form of convected heat. The percentage of total heat generated and given off in the form of convected heat is therefore greater for gas-fires than for coal-fires.

The fact that in our experiments the chimney draught was very efficient, might explain why the percentages of convected heat are on an average much lower than those recorded by Mr. Brearley. However, we must not lose sight of the fact that the difference in the figures might result from improvements in gas-fire construction. This will be substantiated in the second part of this report.

Flue Heat or Waste Heat.

We have now considered the comparative heating efficiency of gas and coal fires in so far as their heat is available for warming our rooms. There is another aspect of this question to be considered—namely, the proportion of heat generated which is rendered valueless for warming purposes by ascending the chimney in the form of flue heat. Unfortunately, for the determination of this flue or waste heat, we were forced to make our experiments fit the prevailing circumstances, instead of having the circumstances to fit the experiments. It was our original intention to measure the waste heat by a calorific method. We found that to give effect to our intentions would necessitate greater structural alterations to the flue than we could reasonably request permission to make. After due consideration, we decided to determine the flue heat from the difference between the temperature of the air of the room and the flue gases; the volume of the latter being ascertained by the anemometer.

An opening in the flue was made, 6 feet from the floor; and a glass door was fitted so that the opening could be securely closed while the temperature and velocity of the gases were determined. An iron band and hook were fixed in the centre of the chimney to hold the thermometer and anemometer in position. The temperature registered by the thermometer was under close observation; and, when it was practically constant, a series of anemometer readings were taken and averaged. In this way, we obtained very concordant results. The tables for the flue heats in Appendices VI. and VII. give the observations made as well as the method of calculation.

The percentage of total heat generated in the gas-fires (Appendix VI.) which was lost as flue heat varied from 26 to 58. These results are considerably higher than those recorded by other experimenters; but, obviously, so much depends upon the effectiveness of the draught of the flue that it is no wonder that, under varying conditions, different results are obtainable.

A series of experiments was instituted to determine the flue heat from a coal-fire (see Appendix VII.). Here, again, we were confronted with the same difficulty that we experienced throughout with our coal-fire experiments—namely, the extreme fluctuations in the intensity of the heat developed by the combustion of coal in a domestic fire. Consequently, both the temperature and volume of the waste gases fluctuated greatly; and, although our observations were extended over a whole day and were made at frequent intervals, in order to minimize the effect of these rapid and excessive variations, the final result obtained was not satisfactory. However, we obtained sufficient evidence to confidently make the assertion that at least 75 per cent. of the total heat generated by the combustion of coal in an ordinary domestic fire is lost in the form of flue heat.

Hygienic Efficiency of Gas-Fires Compared with Coal-Fires.

We now come to our second consideration—namely, the hygienic efficiency of gas-fires compared with coal-fires. When considered from a purely scientific standpoint, a comparison of the hygienic efficiency of gas and coal fires entails not only consideration of the probable effects of the combustion of these fuels on the internal air of dwelling-houses, but also on the external atmosphere. The perfect combustion of either coal or gas yields products chemically identical, though the proportion in which they are formed varies. Under ideal conditions, the chimney draught should be so efficient as to draw these products entirely away from the air of a room. Therefore, the two main principles on which the hygienic efficiency of gas and coal fires depends are—First, perfect combustion of the fuel, whether gaseous or solid; and, secondly, effective ventilation by the chimney. Leaving the question of the emission of the products of complete or incomplete combustion into the outer air for consideration later, we will confine attention at present to the comparative effect produced by gas and coal fires on the internal air of dwelling-houses.

The contamination of the air of a room heated by gas or coal under every-day conditions is possible only by a proportion of the waste products of combustion finding their way into the room. Naturally, the degree of contamination is more pronounced if the combustion of the fuel is not perfect. The emission into a room of the waste products of combustion results not only in the pollution of the air, but also in over-drying it, because the discharge of gases of relatively high temperature, possessing great avidity for moisture, renders the air unduly dry. This induces a feeling of discomfort in the inmates. These two undesirable effects—namely, contamination and excessive dryness of the air—constitute the main objections commonly urged against the adoption of gas as a domestic fuel.

The scope of our experimental inquiry was framed so as to prove the accuracy or fallacy of these objections. To determine the percentage of waste products of combustion which are discharged from gas-fires into a room, we experimented on the following lines: The hood already described in our experiments on convected heat was used for this purpose (see Appendix III.). All waste products bye-passed into the room necessarily ascended into the hood, and were discharged into the air of the room from the top of it. We determined the carbon dioxide contents of the air first at the inlet to the hood, and, secondly, at the outlet, and likewise made tests for carbon monoxide by the sensitive method of Nicloux and Gautier, as modified by Kinnicut and Stanford.* We found from experiments that passing the air through concentrated sulphuric acid and soda lime tubes was sufficient to remove formaldehyde and other products of incomplete combustion likely to affect the accuracy of these results.

As in all our experiments, the gas-fires were allowed to develop their full efficiency before observations were made. In fact, the estimation of the percentage of waste products bye-passed into the room was made in conjunction with our determinations of the convected heat. The results obtained are tabulated in Appendix IV., which likewise explains the method of calculation followed. From the table, it will be observed that the percentage of waste gases diffused into the air of the room varied from 0·8 to 5 per cent. in the case of five fires; while the two remaining fires—Nos. 6 and 7—allowed 20 and 19 per cent. respectively of the waste gases to bye-pass.

Obviously the proportion of waste gases diffused into the room from gas-fires must depend upon the efficiency of the chimney draught, the construction of the canopy, and the dimensions of the outlet. It may be assumed, taking into consideration the gas consumed and the total heat developed, that the variation in the efficiency of the flue draught would not be excessive. This was experimentally proved by frequent observations made with the anemometer; and if we consider that in the case of Nos. 6 and 7 fires 7050 and 8913 cubic feet respectively of waste gases admixed with air were passing every hour up the flue, it is obvious that the relatively high percentage of waste gases bye-passed from these fires was due to faulty construction. In new fires which have been put on the market since the tests were made, the construction in this respect has been much improved.

When we examine the tabulated results in detail, we find that the carbon dioxide contents of the air of the room varied from 0·066 to 0·098 per cent. with fires Nos. 1 to 5; the corresponding figures for fires Nos. 6 and 7 being 0·156 and 0·164 respectively. Now, what is the true significance of these figures? Considerable importance is attached to the proportion of carbon dioxide in the air of rooms, as being indicative of the degree of contamination. This is undoubtedly correct, with the reservation that not only the proportion, but also the source, of the carbon dioxide must be taken into consideration. It is an accepted fact that if the carbon dioxide results entirely from respiration, then the proportion of this gas becomes a direct index of the polluted condition of the air, solely because the quantity of it found is in such cases in direct proportion to other products of respiration organic in nature and toxic in properties. The perfect combustion of coal gas yields no toxic compounds; and therefore considerably more latitude is permissible in regard to the proportion of carbon dioxide when a portion of that gas has been derived from combustion. This principle has been adopted by the Departmental Committee on the Ventilation of Factories and Workshops in deciding upon a legal limit for carbon dioxide. Another point of considerable importance is that the tests for carbon dioxide were made after the fires had been burning six hours, so that we cannot be accused of putting forward results too favourable to gas-fires. On the contrary, the reverse is the case. There can, however, be no doubt that this proportion of carbon-dioxide, due to gas combustion found in the air of a room, is incapable of producing any injurious physiological effect.

We have already stated that, if the products of incomplete combustion of either coal or gas were discharged into the room, the contamination of the air thereof would be greatly aggravated. Careful experiments were made to determine the presence and estimate the amount of carbon monoxide in the air of the rooms; and in every case, with the exception of one, the results were entirely negative. Coal-fire experiments on similar lines were made; and the results are shortly summarized in the statement that, under normal conditions of chimney draught, we found that no waste products, either of complete or incomplete combustion, were bye-passed into the room, while the carbon dioxide content of the air in the room was not materially increased.

These results will occasion no surprise when we state that the average flow of chimney gases was, in the case of coal-fires, not less than 17,500 cubic feet per hour, which is equivalent to changing the air of the room ten times every hour. Gas-fires are equally efficient as ventilating mediums as coal-fires; for though only in one case was the volume of waste gases passing up the flue per hour found to approach that of coal-fires, yet such an outgoing volume as 17,500 cubic feet is altogether unnecessary. It tends to cause draughts, and results in great loss of heat; while it is doubtful whether a corresponding increase in ventilating efficiency is thereby to be obtained, as such an excessive pull must increase the short-circuiting between the door, the windows, and the chimney.

* *Journal of the American Chemical Society*, 1900, Vol. XXII., p. 14.

The ventilating efficiency of gas-fires may be shown by the volume of waste gases passing up the flue per hour—

No. of Gas-Fire.	Waste Gases Passing per Hour in Cubic Feet.
1	6,440
2	7,993
3	14,181
4	9,810
5	7,884
6	7,050
7	8,913

From this it will be observed that the minimum volume is equivalent to a change in the air 3·7 times per hour, while the average equals 5·2 times—figures that are quite satisfactory from a hygienic point of view.

Having demonstrated that the ventilation efficiency of gas-fires compared favourably with that of coal-fires, and that no vitiation of the air of rooms is occasioned by gas-fires, we direct attention to the results of a series of experiments made to determine the comparative effect of gas and coal fires on the humidity of the air. Two rooms exactly similar in regard to dimensions and situation were set apart for the tests; one being heated by gas and the other by coal. Both rooms were aired during the night, and the temperature was recorded each day fifteen minutes after closing the windows. The temperature was taken by wet and dry bulb thermometers—one set placed 5 feet from the floor and the other at the ceiling; half-hourly readings being taken throughout each experiment. It is, perhaps, unnecessary to state that the thermometers were so placed that they were not affected either by the radiant heat from the fires or by convected heat from the walls. In the tables in Appendix VIII., the humidity is expressed as the ratio of the amount of moisture actually in the air to that necessary to saturate it at the observed temperature; the saturation quantity being taken at 100.

In this way, we experimented with gas-fires consuming varying quantities of gas; the consumption of coal being regulated accordingly so as to maintain the temperature of both rooms as nearly as possible at the same level. In each experiment, the coal-fire was replenished under similar conditions to those prevailing in an ordinary household. The tables given in Appendix VIII. prove that the common objection to gas-fires—namely, that they cause undue dryness of the air—is not based upon fact. On the contrary, our experiments unmistakably demonstrate that gas-fires exert no more drying effect on the air of rooms than ordinary coal-fires.

In any attempt to compare the economical aspects of gas-fires for dwelling-houses as against those of coal-fires, we are at once faced by considerations favourably affecting the former which do not attach to the latter. We will consider these after an attempt has been made to select from the nine tables constituting Appendix II. one which seems to offer, from the results obtained, a fair basis of comparison.

Meanwhile, leaving convenience, ease of regulation, rapidity of effect, cleanliness, and non-production of solid waste products on one side, let us look at one of the tables which appears to show the results from both gas and coal firing to be pretty equal—namely, No. 4—and see what the exact difference is in money value, burning from 10 a.m. until 4 p.m. This experiment was made on Jan. 28, 1908; and in both rooms the temperature 5 feet from the floor was found to be 43° Fahr., and the humidity to be 84 per cent. The gas-fire and the coal-fire were lighted together at 10 a.m.; the former consuming gas at the rate of 29·8 cubic feet per hour, and the latter started with 1 lb. of dry sticks and 7 lbs. of coal.

At the end of the first hour, we had spent 0·7150d. for gas (at 2s. per 1000 cubic feet), and 0·6562d. for coals, at 10½d. per cwt., exclusive of the sticks. At 11 a.m., the air in the gas-fired room had risen from 43° to 51° Fahr., with 74 per cent. of humidity; while the air of the coal-fired room had only risen from 43° to 47°, with 86 per cent. of humidity. In another hour, with the same relative expenditures, we had 54° of heat and 69 per cent. of humidity for the gas-fire, and 52° of heat and 74 per cent. of humidity for the coal-fire.

It will be observed from the table that at 1 p.m. (three hours after starting) the air of both rooms, 5 feet from the floor, had attained the same temperature and the same humidity—viz., 56° and 65 per cent.—but that the coal-fire had reached this point by much lower gradations than the gas-fire. At 1 o'clock, 2·1456d. worth of gas had burned, compared with 1·9687d. worth of coal, or only 0·1769d. in favour of the coal-fire. Two hours after, or at 3 p.m., the air of the gas-fired room had reached the comfortable temperature of 61° Fahr.; while, notwithstanding that 7 lbs. of fresh coal had been added at 2 p.m., the temperature of the other room still remained at 56° Fahr. At 4 p.m.—the closing hour—the air of the gas-fired room had risen 1° to 62°, with 62 per cent. of humidity; while the air of the coal-fired room had suddenly jumped from 56° to 61°, with the same humidity—viz., 62 per cent.

The total expenditures for the six hours' trial were: For gas, 4·2912d.; for coal, 2·9062d—1·385d. in favour of coal. If the price of gas were 16d. per 1000 cubic feet, instead of 24d., the cost of the two fires would have been identical, with a manifest advantage from the gas-fire in rapid, even, and progressive heating power to the maximum, and an instantaneous extinction when no longer required. But even with the extra 1½d., gas can claim, as we have already indicated, a convenience and simplicity of regulation impossible with coal; a rapidity of effect, as shown in this and other tables, which coal-fires cannot attain to; and an absence of dirt and dust and ashes which we think may easily compensate every cleanly housewife for the fractional saving she can make in money by burning coal.

We are therefore of opinion that, even when fires are required for continuous daily use, if gas is burned in properly constructed grates or stoves, and the cost of service for attending coal-fires, and the extra work entailed in dusting, sweeping, and washing because of them, are added to the price of the fuel, the cost of heating by gas compares very favourably with the cost of heating by coal.

Where domestic cooking alone is the consideration, or when rooms require to be rapidly heated and kept at an even temperature for short periods, gas-fires are not only more convenient, but will cost less than coal-fires, even with gas at its present price.

Effects of Gas-Firing on the Atmosphere.

Finally, we may be permitted to add a few words upon the effects that the more general adoption of gas-firing in dwelling-houses and other occupied premises would have upon the atmosphere of the city.

As previously stated, the perfect combustion of either gas or coal yields products chemically identical—differing only in the proportion in which they are produced. The perfect combustion of a fuel necessitates that the temperature of the fuel and its products must be maintained at or above their ignition point; while at the same time each particle of fuel must be brought into contact with an adequate supply of air. By the employment of a gaseous fuel, such as coal gas, these conditions are easily secured, and require only the intelligent use of a modern gas fire or stove. On the other hand, the perfect combustion of coal in an ordinary domestic grate is an impossibility, as the two essential conditions for perfect combustion can only be imperfectly fulfilled. We are therefore confronted with the fact that the atmosphere is constantly being vitiated with the discharge from domestic chimneys of the visible and invisible products of the incomplete combustion of coal. The general conception of smoke and its composition is that it consists almost entirely of finely-divided particles of unconsumed carbon, and that the obnoxious qualities of smoke are proportional to its density and colour. This is incorrect. Smoke is a body of great complexity; its composition depending not only on the nature of the substance burned, but on the temperature prevailing during the formation of the smoke.

In order to demonstrate the polluting nature of the discharges from domestic chimneys, we made a series of estimations of the principal products of incomplete combustion. The results are tabulated, and indicate very plainly that, by the adoption of gas as the domestic fuel, the pollution of the atmosphere would be greatly reduced. We might, with advantage, make a few observations on the results obtained.

Proportion of Products of Incomplete Combustion in Flue Gases.

	Coal-Fires.	Gas-Fires.
Carbon and other solid matter	13·58 lbs. per million cubic feet	*Nil*
Hydrocarbons	5·40 ,, ,, ,,	*Nil*
Carbon monoxide	24·17 parts per 100,000 parts flue gas	3·2 parts
Sulphur dioxide	1·36 ,, ,, ,, ,,	Trace
Ammonia	0·822 ,, million ,, ,,	0·085 part

Solid Impurities.

From the tabulated statement, it will be observed that the chimney gases from a coal-fire contain, on an average, 13·58 lbs. of solid matter per million cubic feet; while the chimney gases from a gas-fire are entirely devoid of any trace of solid matter. In order to impart to the lay mind a practical conception of what the 13·58 lbs. per million cubic feet means, we may state that this quantity is equivalent to fully 5 per cent. of the coal consumed.

Semi-Gaseous and Gaseous Impurities.

As we have demonstrated by former experiments, the domestic coal-fire is the source of what, to our mind, is the most objectionable constituent of smoke—namely, hydrocarbons. These compounds are produced by the partial distillation of coal which occurs in ordinary domestic fires. They are practically solid at ordinary temperature, black in colour, and when liquefied possess physical properties akin to a heavy oil. As the result of washing the gases formed in an open fire-grate by means of a spray, a considerable quantity of the impurities were collected, which on analysis gave the following results:—

Mineral matter	22·0 per cent.
Carbonaceous matter	41·1 ,,
Oily hydrocarbons	36·9 ,,

From a series of experiments which we conducted over several months, it was found that a million cubic feet of chimney gases from an ordinary domestic fire, burning under usual conditions, contained 5·4 lbs. of these hydrocarbons. These impurities are most objectionable, as besides being conducive to the formation of that abomination black fog, they retard its dispersion, because on a reduction of atmospheric temperature they are condensed and precipitated with the accompanying moisture—forming an oily envelope surrounding the globules of condensed water, which prevents evaporation to a very considerable extent.

The tabulated results show that not only are coal-fires the source of solid and semi-gaseous impurities, but they also discharge a considerable amount of gaseous impurities into the atmosphere—notably that poisonous gas carbon monoxide. A

perusal of the tabulated results can lead to only one conclusion—namely, that by the general adoption of gas as a domestic fuel not only would our atmosphere be rendered more pellucid, but that the evils arising from that abomination black fog would be greatly minimized.

The Royal Commission on Coal Supplies accepted 32 million tons as representing the domestic consumption of coal for the year 1903. As we have shown, fully 75 per cent. of the available heat contained in these 32 million tons of coal is lost; and fully 5 per cent., or 1½ million tons, of unconsumed carbon are annually thrown into the atmosphere, thereby increasing the density of fogs and necessitating untold expense.

Conclusion.

We feel assured that, after a careful study of the facts and figures herein presented, the citizens will readily acknowledge that the smoke-producing, wasteful domestic coal-fire must be replaced by the more cleanly, evenly, and healthy gas-fire before we can hope to obtain a purer atmosphere, or even begin in earnest with the work of air purification.

In closing, we beg to acknowledge the services of Mr. T. Cockburn, who, under the directions of the Corporation Chemist, carried out the elaborate series of experiments upon which this report has been based.

Appendix I.—*Radiation Tests of Gas-Fires.*

No. of Fire.	Pressure in Tenths of an Inch.	Consumption in Cubic Feet per Hour.	Area of Fuel in Square Inches.	Height of Galvanometer in Feet.	Galvanometer Readings. Left. 1	2	Centre. 3	4	5	Right. 6	7	Total.	Common Standard.
1	17	19·8	84	1	12	17	19	19	10	18	12	116	86
				2	4	4·5	7	8	7·5	5	4	40	
				3	2·5	4	4	4	4	3·5	2	24	
				4	1	1·5	1·75	2	1·5	1·5	1	10·25	
2	17	22	100	1	12	21	21·5	22	21·5	21	12	131	81
				2	3	6	8	9	8	6	3	43	
				3	2·5	3·5	4	5	4	3·5	2·5	25	
				4	1	1	1·5	2	1·5	1	1	9	
3	16	40	105	1	17	28	38	40	38	27	17	20·5	70
				2	5	10	22	24	23·5	13·5	7	105	
				3	3·5	6	8	10	8·5	6·5	3·5	46	
				4	2	2·5	3·5	3·5	3	2	1·5	18	
4	16	29·8	105	1	18	30	39	40	39	30	18	214	91
				2	15	27	31	34	31	27	15	180	
				3	4	7	10	12	10	7	4	54	
				4	2	3	4	4·5	4	3	2	22·5	
5	16	34	Iron frets	1	26	47	56	60	57	47	25	318	90
				2	19	33	43	47	44	37	20	243	
				3	10	20	26	26	24	17	9	132	
				4	3	3·5	11	13	11	4·5	3	49	
6A	16	33	132	1	25	43	58	70	59	46	25	326	135
				2	25	36	44	49	45	35	24	258	
				3	9	20	25	29	25	21	9	138	
				4	4	7·5	7·5	9	8	7·5	5	48·5	
6B	14	20	..	1	7	16	23	28	23	16	7	120	82
				2	5	15	22	25	23	15	5	110	
				3	5	10	15	17	14·5	10	5	76·5	
				4	4	5	6	7	6	5	4	37	
7A	15	40	108	1	24	47	67	78	65	46	23	350	120
				2	23	36	48	57	48	36	23	271	
				3	12	23	30	34	30	22	11	162	
				4	4	11	17	19	17	10·5	3·5	82	
7B	14	34	Four centre bunsens off	1	24	32	44	51	43	31	23	248	91
				2	20	27	35	42	34	26	20	204	
				3	12	18	25	28	25	18	12	128	
				4	4	10	14	15	14	10	4	71	

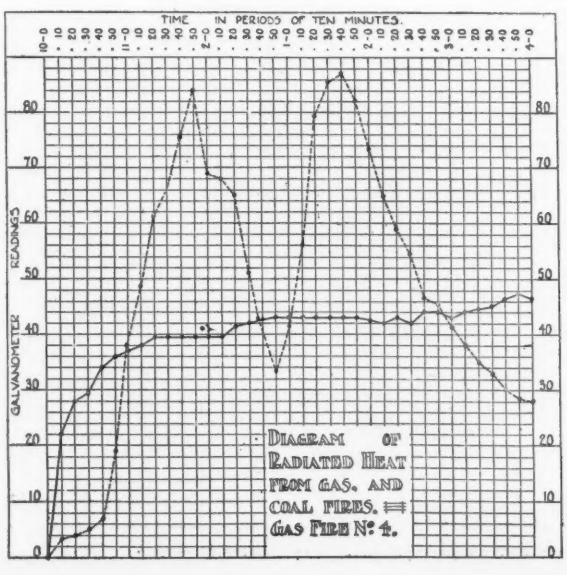
A semicircle 3 feet in diameter was marked off on the floor, with the middle fret of the fire as the centre, and galvanometer readings were taken with the thermopile placed on the semicircle, at a height of 1 foot, and at distances of 1 foot apart, beginning from the left. Seven readings were taken. This was repeated at heights of 2, 3, and 4 feet.

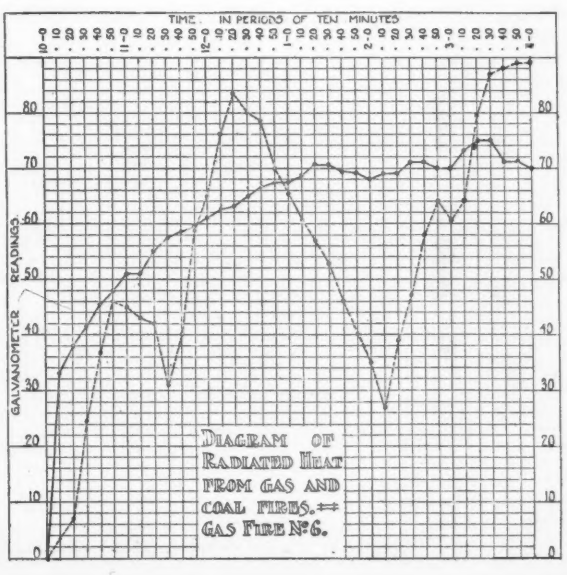
The calorific value of the coal gas as determined was 623 B.Th.U. (gross) per cubic foot. The figures in the last column were obtained from the readings at a height of 1 foot by the formula.

Total readings, × 100 × 600 ÷ actual consumption, × 623 × 7 (number of galvanometer readings).

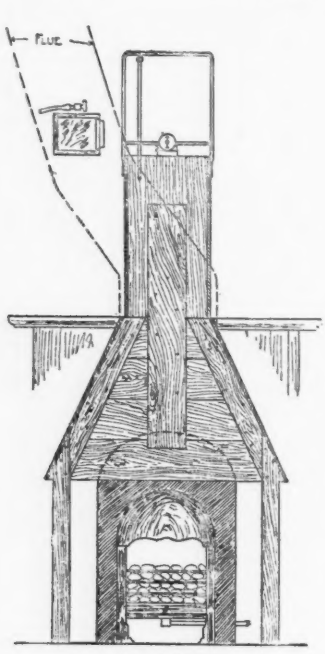
The figures are thus reduced to a common standard of 100 cubic feet consumption of gas with a calorific value of 600 B.Th.U. (gross) per cubic foot.

Appendix II.

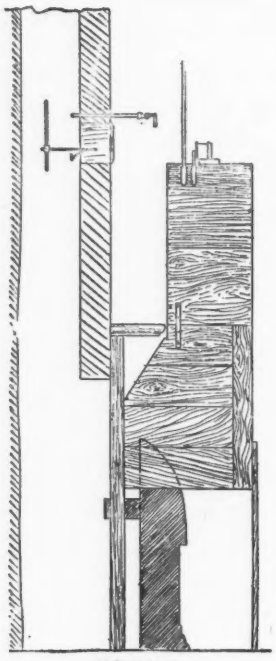




Appendix III.



Front View.



Side View.

Appendix IV.—*Convected Heat from Gas-Fires.*

Room.	No. of Fire.	Pressure in Tenths of an Inch.	Gas Consumed in Cubic Feet per Hour.	Total Heat Units Generated per Hour.	Temperature of Air in Degrees Fahr.			Anemometer Reading.	Air passing through Hood per Hour (corrected to 62° F.)		Heat in Air passing through Hood.		Carbon Monoxide. Parts per 100,000.		Carbonic Acid in Percentage.			CO_2 passing up Hood in Cubic Feet per Hour	Total CO_2 Produced in Cubic Feet per Hour.	Waste Gases Bye-passing per Hour.
					At Inlet.	At Outlet.	Difference.		In Cubic Feet.	In Lbs.	B.T.U.'s.	Per cent. of Total.	In Flue Gas.	In Heated Air.	Inlet	Outlet.	Excess at Outlet.			
1.	2.	3.	4.	5.	6.	7.	8.	8b.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
A	1	17	19·8	12,335	55·2	63·5	8·3	105	6,279	439	874	7	1·6	Nil	·066	·068	·002	0·12	10·29	1·0
B	2	16	21·5	13,394	55·4	73·9	18·5	140	8,210	574	2548	19	1·3	Nil	·059	·060	·001	0·08	11·18	0·8
A	3	17	40·0	24,920	59·9	81·5	21·6	155	8,962	627	3240	13	1·2	Nil	·057	·059	·002	0·17	20·80	0·8
B	4	16	30·0	18,690	61·7	90·8	29·1	160	9,096	636	4441	23	*10·9	Nil	·060	·065	·005	0·45	15·60	2·0
A	5	14	34·0	21,182	61·5	76·8	15·3	155	9,040	633	2324	10	9·8	Nil	·098	·108	·010	0·90	17·68	5·0
B	6	18	33·0	20,559	61·7	83·4	21·7	160	9,217	645	3359	16	2·0	Nil	·156	·195	·039	3·60	17·16	20·0
A	7	12	42·0	26,166	73·4	118·4	45·0	185	10,231	716	7732	29	4·3	2·0	·164	·205	·041	4·20	21·84	19·0
	Ball fuel fire	14	42·0	26,166	55·4	72·0	16·6	100	5,946	416	1657	6	..	Nil	..	..	..	..	..	..

* Using columnar fuel raised 1½ inches above the bunsens, and adjusting the flame until it was very hard, this figure was reduced to 2·4.

Note, in column 14, if the air of the room be taken as a standard, instead of the outside air, no carbon monoxide was given off by the fires, with the exception of No 7.

Notes.

The calorific value of the gas as determined was 623 B.Th.U. (gross) per cubic foot.
Column 5 is the multiplicand of the above value and column 4.
Column 6 is the average of the readings of two thermometers at a height of 3 feet from the floor, screened from direct radiation.
Column 8B was obtained by an average of several anemometer readings. In column 9 the volume was reduced to 62° Fahr. (16·6 C.).
Column 10 was obtained from the factor "1 cubic foot of air weighs 0·07 lb.," using the corrected volume above.

Notes.

Column 11 is the multiplicand of columns 8, 10, and 0·24 (specific heat of air).
The sample for CO_2 (column 15) was taken in the same position as for the ingoing temperature; that in column 16 was taken 6 inches below the top of the hood.
Column 18 was obtained from columns 9 and 17.
Column 19 is obtained by multiplying the figure in column 4 by 0·52 (the CO_2 produced by the combustion of 1 cubic foot of gas).
Column 20 is the percentage ratio of columns 18 and 19.

Appendix V.—*Convected Heat from Coal-Fire.*

Time.	Temperature in Degrees Fahrenheit.			Anemometer Reading.	Air passing through Hood per Hour (corrected to 62° Fahr.).		Heat in Air passing through Hood.	
	In Room.	At Top of Hood.	Difference.		In Cub. Ft.	In Lbs.	B.Th.U.'s.	Percentage of Total.
10.30 a.m.	53·6	56·3	2·7	67	4064	284	185	
11 ,,	55·0	62·6	7·6	90	5392	377	694	
11.30 ,,	54·7	59·5	4·8	80	4821	337	388	
12 noon	56·3	65·8	9·5	108	6431	450	1026	
12.30 p.m.	58·1	67·6	9·5	100	5934	415	946	
1 ,,	60·0	69·4	9·4	103	6091	426	961	
1.30 ,,	58·3	68·3	10·0	98	5807	406	974	
2 ,,	57·2	63·5	5·3	75	4486	314	391	
2.30 ,,	57·2	61·7	4·5	70	4200	294	307	
3 ,,	58·4	67 9	9·5	104	6169	432	985	
3.30 ,,	60·6	70·6	10 0	108	6374	446	1070	
4 ,,	60·2	77·9	17 7	102	5938	415	734	
							8661	2·3

Note.—Total weight of coal used, 28 lbs. Calorific value = 7417, equivalent to 13,350 B.Th.U.'s per lb. of coal.

APPENDIX VI.—*Flue Heat from Gas-Fires.*

Room.	No. of Fire.	Gas Consumed in Cubic Feet per Hour.	Pressure in Tenths of an Inch.	Total Heat Units Generated per Hour.	Temperature in Degrees Fahrenheit.			Anemometer Reading in Flue.	Waste Gases passing up Flue (corrected to 62° F.).		Heat Carried Away in Waste Gases.	
					In Room.	In Flue.	Difference.		In Cub. Ft.	In Lbs.	B.Th.U.'s.	Percentage of Total.
1	2	3	4	5	6	7	8	9	10	11	12	13
A	1	19·8	17	12,335	55·2	86·9	31·7	150	6,440	450	3,708	30
B	2	21·5	16	13,394	55·4	104·0	48·6	192	7,993	559	7,063	52
A	3	40	17	24,920	59·9	117·5	57·6	350	14,181	992	14,858	59
B	4	30	16	18,690	61·7	190·5	28·8	230	9,810	686	5,136	27
A	5	34	14	21,182	61·7	105·8	44·1	190	7,884	551	6,317	29
B	6	33	18	20,559	61·7	118·4	56·7	170	7,050	493	7,267	35
A	7	42	13	26,166	73·4	93·2	41·8	210	8,913	623	6,770	26
B	Ball fuel fire	42	14	26,166	55·4	127·4	72·0	290	11,592	811	15,182	58

Taking the area of the chimney flue as ¾ square foot, column 10 is obtained by multiplying column 9 by (¾ × 60), and then bringing to a temperature of 62° Fahr. (16·6° C.). The calorific value of the coal gas, as determined, was 623. Column 11 is the multiplicand of column 10 and 0·07 (weight of 1 cubic foot of air). Column 12 is the multiplicand of column 8, column 11, and 0·26 (specific heat of waste gases).

Note.—In gas-fire No. 7, when the air shutters of the back of the fires were closed, the anemometer reading in the flue was only 30 feet per minute, and the temperature was 132·8 Fahr. The carbon monoxide in the flue was 8·1 parts per 100,000, and at the top of the hood 4·6 parts per 100,000. The carbon dioxide in the room at 4 p.m. was at inlet of hood 0·217 per cent., and at top of hood 0·256 per cent.

APPENDIX VII.—*Flue Heat from Coal-Fire.*

Time.	Temperature in Degrees Fahrenheit.			Anemometer Reading in Flue.	Waste Gases passing up Flue per Hour (corrected to 62° Fahr.).		B.Th.U.'s in Waste Gases passing away.
	In Room.	In Flue.	Difference.		In Cub. Ft.	In Lbs.	
10.30 a.m.	53·6	179·6	126·0	450	16,519	1156	37,870
11 ,,	55·0	122·0	67·0	380	15,331	1073	18,691
11.30 ,,	54·7	131·0	76·3	410	16,290	1140	22,615
12 Noon	56·3	185·0	128·7	510	18,565	1399	46,813
12.30 p.m.	58·1	222·8	164·7	520	17,880	1251	53,570
1 ,,	60·0	210·2	150·2	460	16,158	1131	44,167
1.30 ,,	58·3	143·6	85·3	480	18,670	1307	28,986
2 ,,	57·2	93·2	36·0	400	16,979	1188	11,119
2.30 ,,	57·2	150·8	93·6	480	18,452	1291	31,417
3 ,,	58·4	185	126·6	490	17,836	1248	41,078
3.30 ,,	60·6	167	106·4	510	19,098	1336	36,959
4 ,,	60·2	167	106·8	510	19,098	1336	37,098

APPENDIX VIII.—*Comparative Heating Value and Humidity Tests of Gas and Coal Fires.*

The corresponding rooms were aired all night, and the temperature taken in the morning 15 minutes after the windows had been closed. The fires were then lit simultaneously, and the temperatures recorded by wet and dry bulb thermometers; No. 1 being situated 5 feet from floor, and No. 2 at the ceiling. The fires were replenished simply as they would be in a house—that is, a certain quantity of coal was put on, allowed to burn until the fire was dying down, when a fresh quantity was added. The humidity is expressed as the ratio of the amount of water actually in the air to the amount which would be necessary to saturate it at the observed temperature, this "saturation quantity" being taken as 100.

Test No. 1.

Gas-Fire No. 1.										Coal-Fire.								
Room.	Time.	Pressure in Tenths of an Inch.	Gas Consumption in Cubic Feet per Hour.	Thermometer Readings.						Room.	Time.	Coal Used.	Thermometer Readings.					
				5 Feet above Floor.			At Ceiling.						5 Feet above Floor.			At Ceiling.		
				Dry Bulb.	Wet Bulb.	Humidity.	Dry Bulb.	Wet Bulb.	Humidity.				Dry Bulb.	Wet Bulb.	Humidity.	Dry Bulb.	Wet Bulb.	Humidity.
A	10 a.m.	16	20	38	36	83	38	36	83	C	10 a.m.	{7 lbs. / 1 lb. sticks}	39	36	77	40	37	76
	10.30 ,,	,,	,,	39	37	84	40	37	76		10.30 ,,	..	42	38	72	41	38	77
	11 ,,	,,	,,	42	39	78	43	40	78		11 ,,	..	45	41	72	45	41	72
	11.30 ,,	,,	,,	42	39	78	43	40	78		11.30 ,,	7 lbs. more	47	43	73	47	43	72
	12 noon	,,	,,	43	40	78	44	41	77		12 noon	..	47	43	73	47	42	67
	12.30 p.m.	,,	,,	44	41	77	45	42	78		12.30 p.m.	7 lbs. more	48	43	67	48	43	67
	2 ,,	,,	,,	45	42	78	45	42	78		2 ,,	..	52	45	59	51	45	63
	2.30 ,,	,,	,,	46	43	79	46	43	79		2.30 ,,	..	53	46	59	51	45	63
	3 ,,	,,	,,	47	44	79	47	44	79		3 ,,	..	52	45	59	51	45	63
	3.30 ,,	,,	,,	47	44	79	47	44	79		3.30 ,,	..	52	45	59	51	45	63
	4 ,,	,,	,,	47	44	79	48	44	73		4 ,,	..	51	45	63	51	45	63

Test No. 2.

Gas-Fire No. 2.										Coal-Fire.								
B	11 a.m.	15	22	39	37	84	39	37	84	D	11 a.m.	{7 lbs. / 1 lb. sticks}	39	37	84	39	37	84
	11.30 ,,	,,	,,	41	39	84	42	40	85		11·30 ,,	..	43	40	78	42	39	78
	12 noon	,,	,,	44	41	77	45	42	78		12 noon	7 lbs.	45	42	78	45	42	78
	12.30 p.m.	,,	,,	44	41	77	45	42	78		12.30 p.m.	..	45	42	78	44	41	77
	2.30 ,,	,,	,,	48	44	73	50	45	68		2.30 ,,	7 lbs.	47	44	79	47	43	73
	3 ,,	,,	,,	48	44	73	50	45	68		3 ,,	..	46	43	79	45	42	78
	3'30 ,,	,,	,,	49	45	73	51	46	68		3.30 ,,	..	50	45	68	51	45	63
	4 ,,	,,	,,	50	46	74	53	47	64		4 ,,	..	52	47	69	53	48	69
	5 ,,	,,	,,	51	46	68	53	48	69		5 ,,	..	51	46	68	53	48	69

Test No. 3.

Gas-Fire No. 3.										Coal Fire.								
A	10 a.m.	14	36	42	39	78	42	39	78	C	10 a.m.	{7 lbs. / 1 lb. sticks}	44	40	71	44	40	71
	10.30 ,,	,,	,,	45	42	78	46	43	79		10.30 ,,	7 lbs.	46	42	73	46	42	73
	11 ,,	14	35	50	46	74	53	48	69		11 ,,	..	48	43	67	48	43	67
	11.30 ,,	,,	,,	52	48	74	55	49	65		11.30 ,,	..	51	46	68	50	45	68
	12 noon	15	32	54	49	69	57	51	65		12 noon	10 lbs.	52	47	69	52	46	64
	12.30 p.m.	,,	,,	55	50	70	59	52	61		12.30 p.m.	..	53	48	69	53	47	64
	1 ,,	,,	,,	56	51	70	59	52	61		1 ,,	..	54	48	64	54	47	59
	1.30 ,,	,,	,,	57	51	65	60	53	62		1.30 ,,	4 lbs.	56	49	60	56	48	56
	2.30 ,,	,,	,,	58	52	66	61	53	58		2.30 ,,	7 lbs.	57	49	57	57	48	53
	3.30 ,,	,,	,,	59	53	66	62	54	58		3.30 ,,	..	60	51	54	60	50	50
	4 ,,	,,	,,	59	53	66	62	54	58		4 ,,	..	62	52	50	61	51	50

Test No. 4.

Gas-Fire No. 4.										Coal-Fire.									
Room.	Time.	Pressure in Tenths of an Inch.	Gas Consumption in Cubic Feet per Hour.	Thermometer Readings.						Room	Time.	Coal Used.	Thermometer Readings.						
				5 Feet above Floor.			At Ceiling.						5 Feet above Floor.			At Ceiling.			
				Dry Bulb.	Wet Bulb.	Humidity.	Dry Bulb.	Wet Bulb.	Humidity.				Dry Bulb.	Wet Bulb.	Humidity.	Dry Bulb.	Wet Bulb.	Humidity.	
B	10 a.m.	15	29·8	43	41	84	45	42	78	D	10 a.m.	7 lbs. / 1 lb. sticks	43	41	84	44	41	77	
	10.30 ,,	,,	,,	46	44	86	47	44	79		10.30 ,,	..	45	42	78	45	42	78	
	11 ,,	,,	,,	51	47	74	52	48	74		11 ,,	7 lbs.	47	45	86	49	45	73	
	11 30 ,,	,,	,,	53	48	69	55	49	65		11.30 ,,	..	49	45	73	50	45	68	
	12 noon	,,	,,	54	49	69	57	51	65		12 noon	7 lbs.	52	48	74	53	48	69	
	12.30 p.m.	,,	,,	56	50	65	58	52	66		12.30 p.m.	..	54	50	74	53	48	69	
	1 ,,	,,	,,	56	50	65	59	52	61		1 ,,	..	56	50	65	56	50	65	
	2 ,,	,,	,,	59	53	66	62	54	58		2 ,,	7 lbs.	56	50	65	57	50	61	
	2.30 ,,	,,	,,	60	54	66	63	55	59		2.30 ,,	..	56	50	65	56	49	60	
	3 ,,	,,	,,	61	54	62	63	55	59		3 ,,	3 lbs.	56	50	65	56	49	60	
	4 ,,	,,	,,	62	55	62	64	55	55		4 ,,	..	61	54	62	62	53	54	

Test No. 5.

Gas-Fire No. 5.										Coal-Fire.									
A	10 a.m.	15	35	50	48	86	50	48	86	C	10 a.m.	10 lbs / 1 lb. sticks	51	49	86	51	49	86	
	10.30 ,,	15	36	52	50	86	53	50	80		10·30 ,,	..	54	51	80	54	51	80	
	11 ,,	,,	,,	56	52	75	57	53	75		11 ,,	10 lbs.	57	53	75	57	53	75	
	11.30 ,,	,,	,,	58	54	76	60	55	71		11.30 ,,	..	58	53	71	58	53	71	
	12 noon	,,	,,	59	54	71	60	55	71		12 noon	..	59	53	66	59	53	66	
	12.30 p.m.	,,	,,	61	56	72	62	56	67		12.30 p.m.	10 lbs.	62	55	62	62	55	62	
	1.30 ,,	,,	,,	63	57	67	65	58	63		1.30 ,,	..	65	56	55	64	55	55	
	2 ,,	,,	,,	64	57	63	65	58	63		2 ,,	..	67	58	56	67	57	52	
	2.30 ,,	,,	,,	64	57	63	66	58	60		2.30 ,,	7 lbs.	65	57	59	65	56	55	
	3 ,,	,,	,,	65	58	63	67	58	56		3 ,,	..	65	57	59	65	56	55	
	3.30 ,,	,,	,,	66	58	60	67	58	56		3.30 ,,	..	67	57	52	66	56	52	
	4 ,,	,,	,,	67	59	60	68	59	56		4 ,,	..	68	58	52	67	57	52	

Test No. 6.

Gas-Fire No. 5 (with Varying Gas Consumption).										Coal-Fire.									
A	10 a.m.	16	38	49	47	86	49	47	86	C	10.15 a.m.	14 lbs. / 1 lb. sticks	50	48	86	50	48	86	
	10.30 ,,	,,	,,	52	50	86	56	52	81		10.45 ,,	..	52	48	74	52	48	74	
	11 ,,	,,	,,	56	52	81	60	54	66		11.15 ,,	..	56	51	70	56	51	70	
	11.30 ,,	,,	,,	58	54	76	62	55	62		11.45 ,,	..	59	52	61	59	52	61	
	12 noon	,,	,,	60	54	66	63	56	63		12.15 p.m.	14 lbs.	61	54	62	61	54	62	
	12.30 p.m.	,,	,,	61	55	67	64	56	59		12.45 ,,	..	60	53	62	60	53	62	
	1 ,,	,,	,,	63	55	59	65	57	59		1.15 ,,	..	60	53	62	60	53	62	
	2 ,,	,,	,,	67	59	60	70	60	53		2.15 ,,	..	62	55	62	62	55	62	
	2.30 ,,	14	29	67	59	60	71	61	53		2.45 ,,	7 lbs.	62	55	62	62	55	62	
	3 ,,	,,	,,	67	59	60	70	60	53		3.15 ,,	..	64	56	59	64	56	59	
	3.30 ,,	,,	,,	66	58	60	69	59	53		3.45 ,,	..	66	57	56	66	57	56	
	4 ,,	,,	,,	66	58	60	69	59	53		4.15 ,,	..	66	53	42	66	53	42	

Test No. 7.

Gas-Fire No. 6.										Coal-Fire.									
B	10 a.m.	13	33	44	42	84	44	42	84	D	10 a.m.	10 lbs. / 1 lb. sticks	44	42	84	44	42	84	
	10.30 ,,	,,	,,	49	46	79	50	47	80		10.30 ,,	7 lbs.	47	44	79	48	44	73	
	11 ,,	,,	,,	54	50	74	55	50	70		11 ,,	..	49	46	79	50	46	74	
	11.30 ,,	,,	,,	57	52	70	59	52	61		11.30 ,,	..	53	49	74	54	48	64	
	12 noon	13	30	58	53	71	60	53	62		12 noon	8 lbs.	55	50	70	57	50	61	
	12.30 p.m.	,,	,,	60	54	66	61	55	67		12.30 p.m.	5 lbs.	56	50	65	57	50	61	
	1.30 ,,	,,	,,	63	56	63	64	56	59		1.30 ,,	..	62	53	54	64	54	51	
	2 ,,	,,	,,	64	57	63	66	57	56		2 ,,	7 lbs.	63	55	59	65	55	51	
	2.30 ,,	,,	,,	65	58	63	66	57	56		2.30 ,,	..	62	54	58	64	54	51	
	3 ,,	14	26·5	66	58	60	68	58	52		3 ,,	3 lbs.	65	55	51	68	56	46	
	3.30 ,,	,,	,,	67	59	60	68	58	52		3.30 ,,	3 lbs.	66	56	52	68	56	46	
	4 ,,	,,	,,	68	59	56	69	60	56		4 ,,	..	67	57	52	69	57	47	

(*Note.*—A strong cold draught was blowing in at windows and doors.)

Test No. 8.

Gas-Fire No. 6 (with varying Gas Consumption).										Coal-Fire.									
B	10.15 a.m.	18	35	48	45	79	48	45	79	D	10.15 a.m.	8 lbs. / 1 lb. sticks	47	44	79	47	44	79	
	10.45 ,,	,,	,,	52	48	74	54	49	69		10.45 ,,	6 lbs.	51	47	74	53	48	69	
	11.15 ,,	,,	,,	57	52	70	58	52	66		11.15 ,,	..	54	49	69	55	49	65	
	11.45 ,,	16	32·5	59	53	66	60	53	62		11.45 ,,	7 lbs.	58	52	66	60	52	58	
	12.15 p.m.	,,	,,	61	54	62	61	54	62		12.15 p.m.	..	59	52	61	61	52	54	
	12.45 ,,	,,	,,	63	55	59	64	55	55		12.45 ,,	10 lbs.	62	54	58	64	54	51	
	1.45 ,,	,,	,,	65	57	59	66	57	56		1.45 ,,	..	63	54	55	64	54	51	
	2.15 ,,	16	21·5	66	57	56	67	57	52		2.15 ,,	..	66	56	52	68	56	46	
	2.45 ,,	,,	,,	67	57	52	69	58	50		2.45 ,,	7 lbs.	67	58	56	68	58	52	
	3.15 ,,	,,	,,	68	58	52	70	59	50		3.15 ,,	..	69	58	50	71	58	44	
	3.45 ,,	,,	,,	70	60	53	70	59	50		3.45 ,,	..	70	58	47	72	58	42	
	4.15 ,,	,,	,,	70	60	53	72	60	48		4.15 ,,	..	70	58	47	72	58	42	

Test No. 9.

Gas-Fire No 7.										Coal-Fire.									
Room.	Time.	Pressure in Tenths of an Inch.	Gas Consumption in Cubic Feet per Hour.	Thermometer Readings. 5 Feet above Floor. Dry Bulb.	Wet Bulb.	Humidity.	At Ceiling. Dry Bulb.	Wet Bulb.	Humidity.	Room.	Time.	Coal Used.	Thermometer Readings. 5 Feet above Floor. Dry Bulb.	Wet Bulb.	Humidity.	At Ceiling. Dry Bulb.	Wet Bulb.	Humidity.
A	10 a.m.	14	42	45	43	85	45	43	85	C	10 a.m.	7 lbs. 1 lb. sticks	45	44	92	47	45	86
	10.30 ,,	,,	,,	50	48	86	54	50	74		10.30 ,,	7 lbs.	47	46	93	50	46	74
	11 ,,	,,	,,	58	53	71	62	55	62		11 ,,	..	49	47	86	52	47	69
	11.30 ,,	12	25	52	56	67	66	58	60		11.30 ,,	10 lbs.	51	49	86	55	49	65
	12 noon	,,	,,	63	57	67	66	57	56		12 noon	..	54	51	80	58	51	61
	12.30 p.m.	,,	,,	63	57	67	66	57	56		12.30 p.m.	3 lbs.	58	52	66	59	52	61
	2 ,,	,,	,,	64	57	63	67	57	52		2 ,,	7 lbs.	59	52	61	60	53	62
	2.30 ,,	,,	,,	64	57	63	67	57	52		2.30 ,,	..	60	52	58	61	53	58
	3 ,,	,,	,,	64	57	63	67	57	52		3 ,,	..	61	53	58	63	54	55
	3.30 ,,	,,	,,	65	58	63	68	58	52		3.30 ,,	3 lbs.	63	54	55	65	55	51
	4 ,,	,,	,,	65	58	63	68	58	52		4 ,,	..	64	54	51	66	55	48

This fire (No. 7) was provided with three taps at the bottom. At 11.30 a.m. one of the taps was screwed down, and the consumption lowered to 25 cubic feet per hour.

REGISTER OF PATENTS.

Gas Manufacture.

MEUNIER, S., of Stockport.

No. 23,263; Oct. 31, 1908.

This invention—relating to "the production of gas by the distillation of coal in gas-retorts, and the collection of the gas by means of a hydraulic main, and the usual scrubbers for delivery into a gasholder"—is fully dealt with on p. 29 of this week's issue of the "JOURNAL."

Laying Pipes to a Desired Gradient.

LOCKHART, J. M., and JENKINSON, H. J., of Pendleton.

No. 25,224; Nov. 24, 1908.

This invention relates to an appliance devised to facilitate the laying of pipes to a desired fall or gradient—similar to the "Gradiograph" described in last week's "JOURNAL," p. 890.

The patentees claim: (1) A self-contained instrument, combining a spirit level, a longitudinally arranged and graduated scale attached to the part carrying the level, shiftable scale influencing means acting on the longitudinally arranged scale, and a lockable casing—the scale and its influencing means being contained within the lockable casing. (2) In an instrument for the indicated purposes, the combination of a swivelling spirit level, a longitudinally arranged and graduated scale, and a travelling cursor moving on the scale, with or without means for minutely adjusting the cursor.

Gas-Burners of the Automatic Lighting and Governing Type.

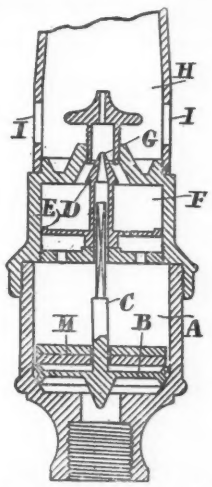
GOZZARD, A., of Sheffield.

No. 1671; Jan. 23, 1909.

This invention relates to a burner which regulates the supply of gas as the pressure in the main varies. The patentee claims to be able to so adjust the valves that, beyond regulating the supply to maintain a constant illuminating power within a considerable range of pressure, he can also, with burners constructed for use in street-lamps and the like, so adjust the burner, by the addition or removal of small weights in the form of discs on the main valve, that when the night pressure is reduced at daybreak the main jet at the burner is extinguished, leaving only the pilot light, and so that when the night pressure comes on the valve again opens and the illuminating jet is relighted—all movements being effected automatically.

In the lower part of the burner shown is a cylindrical valve-chamber A (which also acts as a gas-reservoir), large enough to carry a piston valve B, of sufficient area to be actuated by the lowest range of working pressure. The valve is provided with several projecting lugs on its upper face, which fit the interior of the reservoir and steady the valve when it rises off its seat, and also ensure its return directly on to its seat. On the upper part of this valve is a spindle or stalk C, long enough, when the valve is on its seat and closed, to extend upwards into the stalk or body of a small cylindrical conical ended valve D, provided with flanges E, to fit as a piston in the cylindrical lower portion F of an upper cone-ended valve-chamber formed in the cover of the main valve-chamber, which also forms the seat for the last-named valve. A hole G is provided in the apex of the cone-shaped end of this small valve, which communicates with a larger central orifice in the apex of the cover previously referred to, through which the supply of gas is conducted to the mixing-chamber H of the burner—air inlets I being formed in this mixing-chamber in the usual way. The upper part of the spindle of the main valve may be made square or triangular, so as to provide a passage for gas along the flattened surfaces so formed, into the interior of the body of the small valve, so that when this valve is forced upwards on to its seat by the action of the increased pressure on the main valve, the gas will pass through the central orifice of this small valve into the larger central orifice previously referred to—the orifice in the smaller valve being large enough to supply the requisite amount of gas for a full-sized jet at high pressure.

The action of the burner is as follows: When a slight increase above day pressure comes on, the gas causes the main valve B to rise from its seat, when sufficient gas is admitted into the chamber A to supply a jet of normal power. In this condition the main valve has not risen high enough to lift the governing valve D on to its seat, and sufficient area is therefore left round the outside of the governing valve and through the centre of it to supply the larger central orifice in the apex of the small valve-chamber of the main valve-chamber, whence the gas passes through the mixing-chamber H to the jet. As the pressure increases, the conical-ended



Gozzard's Automatic Lighting Governor.

valve D is gradually forced upwards on to its seat, and the gas then passes into the interior of the small valve between it and the flattened surfaces on the stalk or spindle of the main valve, and through the central orifice into the larger central orifice, and thence through the mixing-chamber to the jet, as before. Subsequently, as the pressure is gradually reduced, the small conical valve first drops from its seat, and, as the pressure is further reduced to the ordinary day pressure, the main valve drops on to its seat, and the jet is then automatically extinguished.

By the simple adjustment of weights K, in the form of discs, placed above the main valve, the burner can be adapted to street-lamps or for indoor use, and by forming a thread in the central orifice in the cover of the valve-chamber, and introducing into it a screwed plug with a central orifice and a valve-seat at its lower end (so that when the valve E lifts it fits into the seat on the lower end of the screwed plug instead of the seat in the cover), the lift of the valve can be varied and regulated.

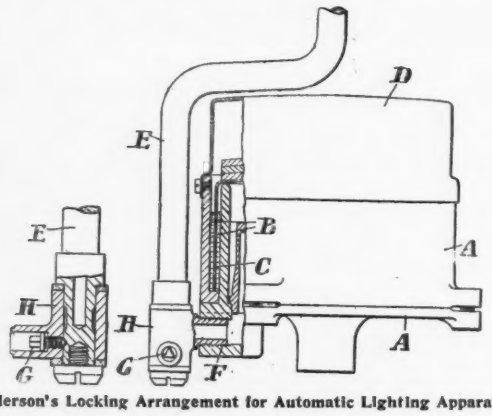
Automatic Gas Lighting and Extinguishing Apparatus.

ANDERSON, J., of New Grange Works, Edinburgh.

No. 3190; Feb. 9, 1909.

The object of this invention is to provide automatic gas lighting and extinguishing apparatus with locking means, to prevent successful tampering; also to prevent dust having access to the mercury seal. It consists in forming the up-pipe to the burner with a swivel, and bending it into close proximity with the top of a cover which closes the device, and providing the up-pipe with locking means, so that when the pipe is in its normal position it is impossible to remove the cover.

There is provided a vessel A, having a mercury seal B, and a bell C



Anderson's Locking Arrangement for Automatic Lighting Apparatus.

operated by gas pressure and actuating a step-by-step valve or other device (not shown) whereby the gas to the burner is controlled—the mechanism being preferably enclosed within the bell, as described in patent No. 19,039 of 1905. Projecting within the vessel may be provided guiding means for the bell, which is protected by a cover D, overlapping the mercury seal, and thereby preventing access of dust to the seal. The up-pipe E is swivelled to the burner at its junction with the gas-exit F from the vessel A, and is provided with any suitable means for locking it in position.

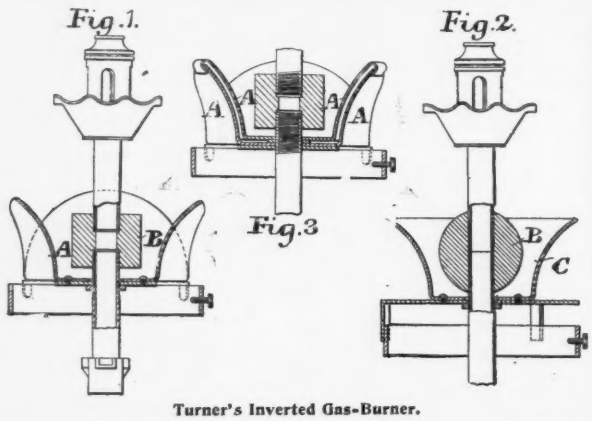
These means may consist of a stud G, screwed into the part H of the swivel joint attached to the vessel, and arranged to screw into recesses I formed in the up-pipe to the burner. The stud can be made with any desired shape of head and placed in a recess, so that only a key having a similar shaped end and long enough to reach to the end of the recess can engage with the stud to lock or release the up-pipe. The up-pipe is bent into close proximity to the cover of the vessel, so that when it is locked in its normal position over the cover it is impossible to remove the latter and so gain access to the interior of the apparatus. When, however, the up-pipe is unlocked and moved away from the cover, easy access to the interior of the apparatus is possible.

Inverted Incandescent Gas-Burners.

TURNER, A., of Amersham.

No. 3859; Feb. 16, 1909.

This inverted incandescent gas-burner is so constructed that the heat imparted to the nozzle or lower part of the burner-tube is not communicated to the mixing-chamber, although the use of insulating material is dispensed with altogether—that is to say (as regards the burner-tube, the deflecting cone, and the burner tip or nozzle), the burner-tube is provided intermediate between its ends with a projecting "body of very considerable bulk or dimensions of heat absorbing and radiating material in conductive connection with the burner-tube."



Turner's Inverted Gas-Burner.

In all the figures of the illustration, the burner-tube, the nozzle at the lower end of the tube, the ring for supporting the globe, the mixing-chamber provided with air admission holes and a gas-nipple, and the shield secured below, and partly surrounding, the air admission holes of the mixing-chamber, are of well-known construction.

In fig. 1, however, the burner-tube is provided at an intermediate portion of its length and above the disperser A with a mass B of heat absorbing and radiating material in conductive connection with the burner-tube, and made not only of a size which is exteriorly of very much greater diameter than the outside of the burner-tube, but also of considerable depth. The upper and lower sections of the burner-tube are screwed into the mass, which consists of a nut of cylindrical or drum shape.

In fig. 2, the mass B is of bulbous form; and the disperser consists of a flat plate secured by lugs to the globe-supporting ring which carries a mask C for hiding the mass.

In fig. 3, two dispersers are used, each consisting of a flat base and a number of upwardly and outwardly bent wings separated from one another, except at their upper edges. In this case, the lower disperser is of ceramic substance, while the upper one is of metal, and serves as a protector for the lower disperser.

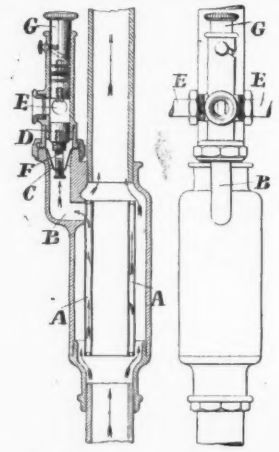
By providing a burner-tube formed of good heat-conducting material intermediate between its ends with a mass of conducting and radiating material, the patentee says that it is possible to superheat the lower end of the burner-tube. "The same effect cannot possibly be obtained if the burner-tube is provided with a number of projecting ribs or discs, for he has found that these ribs do not exercise a cooling effect on the burner-tube, but attract the heated air rising from the burner tip or nozzle."

Temperature Regulators for Gas-Heaters.

RAMASSOT, M., of Lyons, France.

No. 10,215; April 29, 1909. Date claimed under International Convention, March 3, 1909.

The automatic temperature regulators for gas-heaters according to this invention are shown in the engraving.



Ramassot's Gas-Heater Regulator.

The apparatus is mounted on a chamber intercalated at a convenient point in the piping conducting the water from the heater. In it is an annular reservoir A containing an expansible liquid (such as glycerine or a mixture of glycerine and distilled water) and communicating with the channel of the casting B. The liquid contained in A takes the temperature of the water, and in expanding or contracting it acts on a cupped membrane C made of rubber, and causes a vertical movement of a piston D for governing the supply of gas. The piston is of cylindrical shape, and slides in a tube traversed at a right angle by a pipe E conducting the gas to the burners. The orifice of the pipe is proportionally reduced by the plug as the temperature of the water goes up in the water-pipes. An initial regulation of the plug is obtained by varying its position on the rod F which connects it to the cupped membrane. The gas supply can be initially regulated by blocking the orifice of E. For this purpose, in the tube above the orifice is a simple plug G, having a screw passing through a helicoidal slot in the wall of the tube. It is sufficient to turn the plug in one direction or the other to cause it to rise or descend and mask more or less the orifice of E. The course of the plug is calculated so that in the lowest position the piston does not completely close the orifice of E, and, consequently, does not entirely cut off the gas supply to the burners. Further, a screw is arranged which slightly projects below the bottom of the plug G and prevents the complete cutting off of the gas at the time of the rise of the plug D. The screw can be regulated according to the minimum consumption of gas required.

Coking and Gas Generating Ovens.

KOPPERS, H., of Essen-Ruhr, Germany.

No. 12,363; May 25, 1909.

This invention relates to coking and gas generating ovens of the type wherein gas is burnt in heating flues in the walls separating the oven-chambers, and wherein the air for combustion and the products of combustion traverse flues below the chambers. The invention relates, in particular, to the arrangement of the gas-ducts by means of which the several heating flues are fed, and to the means whereby access is had to the flues and gas-ducts for cleaning purposes.

The invention substantially consists in feeding the heating flues by vertical channels, which are coaxial with the several flues and extend directly through the flue-supporting walls from longitudinal gas-channels extending through the walls. The patentee says he finds that with this arrangement the gas traversing the ducts is adequately pre-heated by the adjacent flues traversed by the products of combustion; and the arrangement has the advantage that the structure is less weakened than if the gas is fed from a single main into a heating chamber extending through the furnace. Another advantage is that by providing apertures in the oven-roof, above the heating flues, access can be had to the gas-ducts by means of a bar inserted from above through the flue.

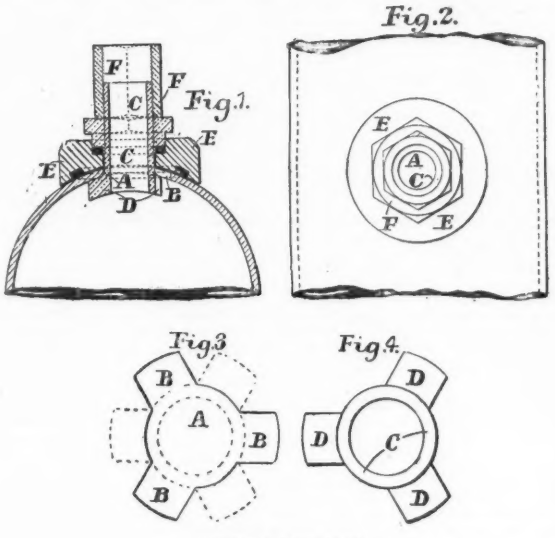
Jointing Pipes.

STEWART, J. G., of Glasgow.

No. 13,997; June 15, 1909.

This invention relates principally to the method of connecting branch pipes to main pipes, by means of flanges formed on the branch pipe and entered through correspondingly shaped openings in the main pipe.

Fig. 1 is a transverse sectional elevation of a main pipe fitted with the means referred to for connecting a branch pipe thereto. Fig. 2 is a



Stewart's Pipe-Joint.

plan. Fig. 3 is a plan of a portion of the main pipe with the fittings removed and formed with an opening of a certain shape. Fig. 4 is a further detail.

An orifice A is made in the pipe at the point where it is desired to connect a branch pipe. The orifice may be circular with any desired number of radial parts or sections B of the circle cut away in its circumference (as shown), or it may be square or triangular. Through the orifice there is passed a short pipe connection C formed with flanges at one end and with screw threads from its other end and for the greater part of its length. There are three parts (in fig. 3) cut away from the circumference of the orifice, or (as shown by fig. 4) there are three flanges D formed on the end of the pipe connection—that is, the flange at the end of the pipe connection would be of the same shape as the orifice and of a slightly smaller size, so as to pass through it. After the end of the pipe connection formed with the flanges is inserted into the orifice A, it is given part of a turn so as to take up the position shown by the dotted lines in fig. 3. A circular plate or cover E, formed with a recess and a hole or passage, is placed around the pipe connection. The plate is of such a size as to cover the orifice; and lead or other packing is fitted (preferably in a groove) between it and the main pipe. A nut is screwed on to the pipe connection so as to enter the recess of the plate E, and packing is fitted between the bottom of the recess and the nut. The surfaces of the plate E next the main pipe, are formed of the same contour as the pipe itself; so that the nut will secure the plate and the pipe connection to the main pipe. A tubular connection F is now screwed on to the pipe connection, and to this connection the branch pipe is screwed.

APPLICATIONS FOR LETTERS PATENT.

29,672.—Cox, F. J., "Production of air gas." Dec. 18.
29,693.—Burbach, E. W., "Ferro-concrete reservoirs." Dec. 18.
29,718.—Tweedale, C. L., "Chimneys and globes." Dec. 20.
29,720.—Preston, J. N., "Gas-governor." Dec. 20.
29,752.—Evans, E. V., "Purification of gas." Dec. 20.
29,778.—Dapine, E., "Generation of gas from liquid hydrocarbons." Dec. 20.
29,798.—Cluderay, E. S., "Pressure-recording apparatus." Dec. 20.
29,872.—Bailey, F. J., "Preparing pipes for jointing." Dec. 21.
29,930.—Fabry, R., "Removing tar from gas." Dec. 22.
29,948.—Nemerovsky, J. M., Everett, L. C., and Nemerovsky, F., "Inverted mantles." Dec. 22.
29,972.—Head, Wrightson, and Co., Ltd., and Wrightson, T. G., "Combined plant for conveying and treating coke." Dec. 22.
30,002.—Giorgi, A., "Inverted gas-lamps." Dec. 22.
30,058.—Paterson, R. H., and Greig, F. W., "Valves and cocks." Dec. 23.
30,060.—Melhuish, A. G., "Gas-pressure raisers or gas-making apparatus." Dec. 23.
30,066.—Falk Stadelmann, and Co., Ltd., and Elliott, G. W., "Incandescent burners." Dec. 23.
30,131.—Guest, A. A., and Gibbons, W. P., "Discharging and charging gas-retorts." Dec. 24.
30,148-9.—Unruh, M. von, "Incandescing bodies." Dec. 24.
30,162.—Schlösser, C., "Automatic gas-valve." Dec. 24.
30,198.—Johnson, J. Y., "Valvular arrangements for controlling the flow of gases from coal-distilling retorts." A communication from Maschinen und Armaturenfabrik vorm. H. Bruer and Co. Dec. 24.
30,229.—Boult, A. J., "Utilization of natural gases." A communication from Albrecht von Groeling. Dec. 24.
30,235-6.—Shanks, J., "Valves." Dec. 24.

Gas Coal Contracts of the Manchester Corporation.—By their contracts, the Gas Committee of the Manchester Corporation are favourably fixed as to prices and supplies of coal up to August next. When, in September, they placed orders for 400,000 tons, the purchases were made at a saving of more than £13,000 compared with the preceding year. In the following month, when the Railway Companies were considering coal contracts, the prices were on the basis of an extra 6d. per ton

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Air-Testing of Gas Plant.

Sir,—Dr. R. Lessing has done good service in calling attention, in his letter in the "Journal" for Dec. 21 (p. 823), to the advantages of employing a more or less inert gas, such as flue gas, in place of air for the testing of new gas plant. He might, I think, at the same time have re-called attention to the extensive use to which flue gases were put for the displacement of air (prior to the admission of coal gas) from practically the whole of the new plant and new distributing system of the Municipal gas undertaking of Vienna in 1899. You shortly afterwards described in your columns the procedure followed on that occasion [see "Journal," Vol. LXXVIII., p. 1657].

A similar precaution is even more necessary when new acetylene plant is being brought into use, owing to the much wider range of composition over which mixtures of air and acetylene are explosive, as compared with mixtures of air and coal gas. In the text-book on "Acetylene," by the late Mr. F. H. Leeds and myself, which was published in 1903, the use of chimney gases for the expulsion of the air from the plant and mains prior to the introduction of acetylene was recommended with large installations. I believe the plan has been followed in some cases.

66, *Victoria Street, S.W., Dec.* 24, 1909. W. J. A. Butterfield.

Cost of Air-Gas Lighting.

Sir,—I would like to call attention to what appears to be a glaring mistake in the communicated article "Air-Gas Lighting," in the last number of the "Journal." Under the heading "The Safety of Air-Gas," and half-way down that section, the costs are given; and it says that 1000-candle power per hour can be got for a cost of 1s. 4d. Further down it is claimed that this cost is considerably less than that for coal gas, electric light, &c. Work out this cost on a basis of 20 candles per cubic foot (which is a very low estimate of efficiency), and you will find that this figure would require to be ¾d. to substantiate the writer's claim.

Dec. 30, 1909. Inspector.

LEGAL INTELLIGENCE.

RATING OF LIVERPOOL WATER-WORKS.

A case in which the Liverpool Corporation were the appellants, and the Chorley Union Assessment Committee and the Overseers of the Withnell Union were the respondents, and which raised a new question in regard to the rating of water-works, recently came before the Magistrates at the Preston Quarter Sessions.

Mr. Macmorran, K.C., and Mr. Oulton appeared for the appellants; Mr. Ryde, K.C., and Mr. Gordon Hewart for the respondents.

Mr. Ryde explained that this was in substance a test case to determine whether the Corporation were liable to be rated at all for the gathering-ground of their water-works, and, so far as a general principle could be laid down, on what principle the ground was to be valued. Originally some seventeen items were to be appealed against; but sixteen had been struck out, leaving the first item. By agreement, the sole question had been left as to whether the land used as gathering-ground was assessable; and, if so, to what amount. The assessment in dispute was £1165; and they were concerned with only 1100 or 1200 of the 10,000 acres acquired. To preserve the purity of the water, the Corporation reduced the number of inhabitants by amalgamating farms, and had also started a very extensive system of planting, in order to prevent the soil being washed away in times of heavy rainfall. They had erected some four miles of fencing, and endeavoured to keep the public off the moorland. In some parts, too, they had put in water channels and pipes to collect the water; and he submitted that, as a matter of law, these acts would constitute the Corporation the owners and occupiers of the land in question. They asked the Court to say that £1 per acre was a fair value to place on the acreage with which they were concerned.

Evidence having been given, Mr. Macmorran said the case was certainly one of the most extraordinary that had arisen, and it sought to assert a principle which, if recognized, would lead to the most extraordinary results all over the country. He wished to emphasize the fact that legal possession was not equivalent to occupation. The Corporation were in legal possession of the ground, and though they could maintain trespass against any person who came unlawfully on it, this was not occupation. He submitted that the mere enclosure of property did not amount to rateable occupation. Counsel added that the principle sought to be established there would work almost a revolution in the law of rating if his friend succeeded in establishing that the turning off of trespassers by an owner constituted an act of occupation. He wished further to emphasize the fact that no one was employed to control the land. If the Bench accepted this view, the rate of £1165 would have to be substantially reduced to such value (which was a small figure) as they would put on the plantations and nurseries.

Evidence having been given by Mr. *Ryde* (of Messrs. Ryde and Sons) and Mr. *Joseph Parry*, M.Inst.C.E, the appellants' Water Engineer, in order to show that there were no acts of occupation in connection with the ground,

Mr. Ryde replied that the value of the land as a gathering-ground far exceeded its value as mere pasture or farm land. If it was found that the respondents could only assess the plantations, he asked that

they should not be limited to the prairie value, but to the value of them for the growing of timber and also for the collection of water. Occupation consisted of a number of rights all taken as a whole; and in this case it was no answer for his friend to take one right out of half-a-dozen and say that by itself it did not amount to occupation.

Mr. MACMORRAN said, presuming the Bench found that there was rateable occupation, he contended that the land was not worth £1 an acre per annum. This was based on an all-round figure of £45 an acre; but the price paid was only £20 16s. 8d. an acre.

Judgment was reserved; Counsel intimating that whatever might be the decision they would ask the Magistrates to state a case.

A Bogus Gas Department Employee.

At the Huddersfield Borough Police Court, Walter Lyons, a canvasser, was charged with obtaining 9d. by false pretences from Ann Potter and 4½d. from Mary Wood. In the first case, prosecutrix said that on Dec. 13 prisoner came to the house saying he was from the Huddersfield Gas-Works, and that he was advertising mantles made by the Gas Department. He was asking 9d. each; but if purchased elsewhere, they would cost 9½d. If the mantles broke within two years, she could have another free of charge from the department. Witness purchased one for 9d. Florence Rowe, manageress for an incandescent gas-fitting dealer, said that from time to time during the last twelve months prisoner had purchased mantles at the shop. She had sold him mantles similar to the one produced at 1s. 6d. per dozen. Mr. J. Crosland, Chief Clerk in the Gas Department of the Corporation, said prisoner had no connection with the department; and, further, they did not deal in mantles. In the second case, the prosecutrix gave evidence that prisoner called saying he was from the gas-works. There had been, he said, innumerable complaints at the works from consumers in respect of mantles; but he had with him some which the Gas Department guaranteed for two years; and if they broke within that period those who had purchased them could go to the office and have them replaced free of charge. Witness bought for 4½d. a mantle for which prisoner said she would have to pay 9d. at certain shops. The Chief Constable remarked that there had been six convictions for false pretences against the prisoner from August, 1904, to April, 1909. Prisoner pleaded guilty, and was sentenced to six weeks' imprisonment in each case, the terms to run consecutively.

Illegally Removing a Gas-Meter.

At the Tottenham Police Court last Thursday, Mr. Charles Gordon, of Rosebery Gardens, Harringay, was summoned by the Tottenham and Edmonton Gas Company for disconnecting a gas-meter without giving notice of his intention to do so, and also for detaining the meter, which was valued at £1 10s. Mr. C. Williams, who appeared for the Company, explained that the defendant entered into occupation of the premises, which the Company were already supplying with gas. They did not know he was there until some time afterwards, when he complained that the meter was not working properly. A new one was supplied, and defendant was called upon to sign the usual contract, which was forwarded to him. He returned the document, saying it was unreasonable, and that it would be against public policy for him to sign it. He was notified that, unless he signed it, the meter would be taken away. He did not do so; and when the Company's servants went to the house, he refused to admit them. They, however, obtained entrance, and then found that the meter had been disconnected. The defendant declined to say where it was. Evidence bearing out this statement having been given, the defendant said he was under no contract with the Company. He found the meter at the house, and used it. The Company took away the first meter with money in it, for which he had not had sufficient gas. He had asked for the return of the money, but had not received it; and he was suing the Company for it. These proceedings were the outcome of that action on his part. The Clerk pointed out that as defendant was a consumer he had no right to disconnect the meter without notifying the Company. It was not a question of contract. Mr. Williams said the Company sent the first meter to be tested, and directly they received the certificate they paid into Court the money claimed by the defendant. It was only 5d. The Bench imposed a fine of 10s. and costs on the first summons. The second was dismissed, as the Court were not satisfied with the evidence that a demand was made for the meter. The defendant said he would appeal; and the Clerk told him he would have to enter into a surety of £50 if he intended doing so.

Reduction in Price at Winsford.—Members of the Winsford (Cheshire) Urban District Council, at their last meeting, had again under discussion the question of reducing the price of gas. The matter was debated at length; and, in the end, a resolution was adopted reducing the price from 3s. 3d. to 3s. per 1000 cubic feet. When the Council acquired the works in 1901, the price of gas was 4s. 2d. per 1000 cubic feet, and each succeeding reduction has brought with it a considerable increase in consumption. This fact was made much of by the advocates on the Council for cheaper gas.

Gas Labourer's Tragic Death.—A labourer employed at the Brierfield (Lancs.) Gas-Works was found in an unconscious state lying in the retort-house, and died later at the Infirmary. At the inquest, it was stated that the deceased, along with a fitter, was working on the top of the retort-stack, and had occasion to go for a tool which the fitter required. As he did not return, the fitter went in search of him, and discovered the man lying unconscious in the retort-house. The man was removed to the Infirmary, where it was ascertained that he had been badly burned on the left side. Deceased had to cross over the retort-stack by planks; and it was suggested at the inquiry that he must have slipped, and, alighting on the back of his head, was rendered unconscious, and therefore unable to call for assistance. As smoke was arising from the stack at the time, the fitter would not be able to see what happened. In returning a verdict of "Accidental death," the Jury recommended that a handrail be constructed on the retort-stack for the safety of the workers.

MISCELLANEOUS NEWS.

SALE OF GAS BY PREPAYMENT METERS.

Interesting Report from Edinburgh.

The Edinburgh and Leith Gas Commissioners had before them on Monday last week a further report by Mr. W. R. Herring, the Engineer and Manager, upon the supply of gas by the prepayment meter system; additional information having been received since the issue of Mr. Herring's report of the 25th of June last, which was given in the "JOURNAL" for July 20 (p. 195).

In his former report, Mr. Herring states, he pointed out that there are 56,906 small consumers, using on an average 10,250 cubic feet, and 11,881 prepayment consumers, with an average use of 5500 cubic feet. The costs of administration are necessarily at per consumer; and as the prepayment consumer burns only one-half the gas, this would alone involve greater expense than in an ordinary case. As a matter of fact, owing to the more frequent reading of the meters and the collection of the money on the spot, the actual cost to the Commissioners, as supplied to Mr. Herring by the collectors' department, was 3·76d. per 1000 cubic feet of gas greater than it was for ordinary consumers. In other words, the prepayment system cost 4·7d. for surveyors, rental-ledger clerks and collectors, and loss by stealing; and as the average for the ordinary consumer was only 0·94d., he had deducted this sum from the 4·7d., making it 3·76d. The increased capital outlay involved further expenditure of 1s. 8d., or 3·63d. per 1000 cubic feet of gas sold. This was made up by the fact that a prepayment meter cost 16s. 7d. more than an ordinary meter, upon which 10 per cent. for interest, depreciation, and maintenance, amounted to 1s. 8d., and on a consumption of 5500 cubic feet, equalled 3·63d. more than it cost in the case of an ordinary consumer. The meters were more complicated, and necessitated more frequent attention, they required more frequent adjustment, and were more often put out of gear through bent coins or tokens being inserted instead of pennies. This was represented by an additional charge of 2s. per consumer, to which he had added the extra cost for repairing the meter when sent to the makers, which in the case of an ordinary meter amounted to 7s., and in that of a prepayment meter to 11s. each; thus making a grand total of 12·2d. per 1000 cubic feet in excess of what it cost to supply a consumer by the ordinary means. No allowance had been made for the fact that they were required to lay a service-pipe for a prepayment supply, which was used to only half the extent that it would be in the case of an ordinary small consumer.

Mr. Herring communicated with meter makers and gas managers upon the subject of the conversion of ordinary 2-light and 3-light dry meters into prepayment meters, and submitted the result of his inquiries in the accompanying table:—

	Average Consumption by Prepayment Meter.	Ordinary Rate for Gas.	Prepayment Rate for Gas.	Increase.	Increase per Cent.	
	Cubic Feet.	s. d.	s. d.	s. d.		
Edinburgh	5,500	3 0	4 2	1 2	38·80	
Glasgow	7,416	2 0	2 7	0 7	29·16	
Manchester	9,077	2 3	2 9	0 6	22·20	(*a*)
Birmingham	14,500	1 10½	2 6	0 7½	33·30	(*b*)
Gaslight and Coke Co.	13,950	2 5	3 1	0 10	34·40	(*c*)
Newcastle	11,341	2 0	2 10	0 10	41·60	(*d*)
Bradford	..	2 1	2 11	0 10	40·00	(*e*)
Leeds	12,400 (with cooker)	2 2	2 8	0 6	23·00	(*f*)
South Metropolitan Co.	..	..	..	..	..	(*g*)
Croydon	17,150	Rates same; have system of winding on.			..	(*h*)

REMARKS.

(*a*) Never converted ordinary to prepayment meters.
(*b*) Found it more profitable to buy new prepayment meters than convert.
(*c*) Never converted ordinary to prepayment meters.
(*d*) Never converted ordinary to prepayment meters. All prepayment consumers new.
(*e*) Do not encourage prepayment meters. Have system of landlord responsibility. Have found it unnecessary to convert.
(*f*) Converted a few; practice found disadvantageous, and was discontinued.
(*g*) Have converted some hundreds of three-lights, and find the practice satisfactory. Thorough overhaul, and repair and convert at 60 per cent. of price of new prepayment meter.
(*h*) Only experimented with conversion; have given up prepayment meters.

The report proceeds: The question at issue is as to whether the Commissioners can sell gas by the prepayment system at a cheaper rate than is at present charged—viz., 1s. 2d. per 1000 cubic feet over and above the ordinary lighting rate—without placing an additional burden on ordinary consumers. In my report of June 25, I have set forth the extra expense incurred in supplying gas by this system, and on these data have expressed the opinion that the 1s. 2d. in excess of the present rate is not more than is justified by the circumstances.

In the event of a reduction in the price being made, are there any grounds for the fears expressed in my report of the 25th of June as to the Commissioners having returned on their hands a large number of ordinary meters which would require to be scrapped? The experience of Glasgow may be mentioned. Glasgow commenced to fix prepayment meters in earnest in the year 1906. They then had 231,184 ordinary meters, and 11,100 prepayment meters. In 1909, they had 225,422 ordinary meters, or 5762 less, and 43,900 prepayment meters.

Can the ordinary meters that would be displaced by prepayment meters be converted to the prepayment system? There are at present 32,791 two-light meters, which cost to-day 21s. 3d. each, and 24,115 three-light meters, which cost to-day 25s. 6d. each. I have already stated

that, in my opinion, this cannot be done, as it amounts to spending at a minimum 20s. to 21s. on each meter, which originally cost 21s. 3d. and 25s. 6d. each respectively, in order to convert it to the prepayment type, which now, with stopcock, lock, stamping fee, &c., complete, cost 36s. 9d., and does not make any allowance for possible repairs to the meter itself, which, in view of the fact that they will average fifteen years old, is almost inevitable when once the old meter is opened up. In Glasgow, they have commenced to convert their three-light meters for the following reason:—"As the number of ordinary meters was being reduced, I did not like the idea of having to scrap them." As far as I can ascertain, no other undertaking is following such a practice; and the meter makers themselves do not recommend it.

In view of the fact that the increased cost per prepayment meter has its origin in the extra cost of the apparatus, meter reading, and collection, &c., this necessarily decreases in proportion to the quantity of gas consumed; but it amounts to the same per individual consumer, whether the consumption is 1000 or 10,000 cubic feet.

If the sliding-scale is adopted which forms the conclusion of my report of the 25th of June, it will have the effect of reducing the price of gas by this system in proportion to the consumption, and is founded on the basis of 20 cubic feet of gas for 1d. up to 5000 feet, and a rebate of 1d. for every additional 1000 feet. Thus a consumer of 10,000 feet per annum would get a rebate of 5d. per 1000 feet, which amounts to a deduction of 4s. 2d. from his annual bill; the rebate being payable to the consumer at each May term for the previous twelve months.

Consideration of the report was postponed to a future meeting of the Commissioners.

THE FATAL FIRE AT CLAPHAM JUNCTION.

The Origin of the Fire.

The inquiry into the circumstances attending the fatal fire which occurred on the premises of Messrs. Arding and Hobbs, at Clapham Junction, on the 20th ult., which was opened by Mr. John Troutbeck at the Battersea Coroner's Court on the 23rd ult., and adjourned for a week, was resumed last Thursday.

Among the representatives of the various interests concerned who were in attendance were Mr. J. J. WASHINGTON, for the South Metropolitan Gas Company, and Mr. P. CAUDWELL for the Battersea Borough Council, who supplied the electricity employed on the premises.

Evidence was given by Mr. *Benjamin Pemberton*, the Counting-House Manager, to the effect that, when the fire occurred, he was in the restaurant with Mr. Herbert Arding, the son of the proprietor, and they were first alarmed by all the electric lights going out. There was only electric light in the restaurant; but there was gas in the rooms above. On approaching the scene of the outbreak, witness saw a flash under an electric light reflector; and at the same time a volume of smoke came through from another room.

Mr. *Herbert Arding* stated that about a month before Christmas they had two gas-lights in the window where the outbreak occurred; but the pendants were taken down and plugged up by their own experienced gas-fitter, and an electric installation was put in. They intended, however, to restore the gas-lights after Christmas. There were about 40 electric lights in the window, and the current was supplied from a different main from that which served the restaurant. The electric installation was put in by Messrs. Holmes and Cooper, and though the firm (Messrs. Arding and Hobbs) desired the work done speedily, they insisted that it should be done thoroughly; and he believed it was carried out under the Phœnix Fire Office rules, which were very strict. Notice was given to the Borough Council to fix the meter and connect the main.

George Lansdell Sander, an assistant window dresser at the window where the outbreak occurred, said he was in the act of removing a Venetian necklace which was suspended in the front of the window by a wire when he heard an explosion which seemed to come from below where he was standing. He was on the shop floor, and reaching into the window. Witness explained that he meant that the sound came from the window below him as he was reaching over. He thought the explosion took place about the middle of the window. The cotton wool with which the window was lined flared up, and he tried to beat out the flames with his hands. His impression was that an electric globe exploded; but he did not know that anything fell on the globe. The globes were not resting on cotton wool, but were 3 inches above it. Pressed as to why he thought a globe blew out, witness said that when he worked at another establishment he once heard a similar noise, and a globe, larger than the one in question, blew out, but the light went out directly it exploded. There were some celluloid and other combs in the front of the window. Questioned by a juror, witness could not say whether the electric light in the window went out after the explosion.

Robert Hutchings said he dressed the window where the outbreak occurred. It was covered with a layer of cotton wool, and was arranged in three tiers. The electric lights ran along the top of the highest tier, and were 9 inches from the wool, while the celluloid combs were in the bottom of the window; and he thought it quite impossible for one of them to have come in contact with the electric light. Witness was in and out of this particular window every day, and at no time had observed anything to suggest an escape of gas. He had had previous experience of electric globes exploding. Once when he was employed in an establishment at Pimlico a globe exploded; but there was no fire. It would not, however, have been a metallic filament lamp, like those used by Messrs. Arding and Hobbs. He had not any experience of an explosion with a metal lamp. He had seen a good many glass globes break and fall on cotton wool without catching fire.

Mr. F. W. BIDDLE, representing Mr. Arding, said that on a future occasion evidence would be called as to the behaviour of metallic filament lamps.

In further examination, witness said it was quite usual to set out show goods in close proximity to electric lamps. He remembered a case at Streatham where a suspended electric lamp came in contact with a fur, and set it on fire. The electric lights in the window he dressed for Messrs. Arding and Hobbs were rigidly fixed on iron shoulders, and he believed no flexible wire was used; but there were pendant lights hanging at the top of the window.

In reply to the CORONER, witness said there were many ways in which the fire might have occurred; but he could not say which was the most probable. Pressed to name some of the ways, witness said the electric wires might have fused.

The CORONER: You suggest that?

Witness: That is as probable as anything else.

The CORONER: Not by a gas explosion?

Witness: There is a possibility that a wrong lamp was put in.

The CORONER: You cannot think of anything else?

Witness replied in the negative.

The inquiry was then adjourned until Jan. 4 (to-day).

THE AUSTRALIAN COAL STRIKE.

Effect on the Gas Supply of Sydney.

A copy of the issue of the "Sydney Morning Herald," dated Friday, Nov. 26, which came to hand yesterday morning, contains, as would naturally be expected, a great deal of information with regard to the deplorable coal strike, the effects of which have been so widespread; and among other things, there are the following statements with regard to the gas supply.

Mr. R. J. Lukey, the Secretary of the Australian Gaslight Company, stated during an interview yesterday [Nov. 25] that the Company only had coal supplies sufficient to last three weeks; and he could not say where they would get any fresh supplies. At the end of that period, unless something unforeseen occurred, the works would have to be closed down, and 1100 men thrown out of employment. "I think we can run for three weeks more," Mr. Lukey said. "The Board are very sorry that the Company cannot extend the mains or services, or supply any new consumers during the currency of the strike. Such a course would not be fair to the present consumers."

The Australian Gaslight Company consume from 3300 to 3500 tons of coal a week. Their present rate of consumption is the lower figure. There are 1100 men in the employ of the Company, the whole of whom will be thrown out of work in the event of the gas-works closing down. There are also a large number of incidental trades that would be affected. The Sydney works have been running for over seventy years; and the present outlook appears more serious than any that has occurred for a long time.

Mr. Morland, the Manager of the North Shore Gas Company, said on the same day that the Company had between three and four weeks' stock of coal. He did not know whether any further coal would be available.

It will be remembered that in last week's "JOURNAL" there was a paragraph to the effect that the Railway Companies furnished a supply of coal to the North Shore Gas Company; but unfortunately it turned out to be unsuitable for making gas. The result was that the district was in darkness on Monday night (Dec. 20), to the great inconvenience of everybody. According to a telegram dispatched on the following day, a supply of coal from the Western district was expected in two days; and a telegram dated Dec. 23 brought the news that the supply of gas had been resumed.

THE CALCUTTA LIGHTING CONTRACT.

Suggestions by Mr. Mansfield.

The new contract with the Oriental Gas Company for the public lighting of Calcutta having now been sanctioned by the Government, a discussion has been proceeding with regard to the Lighting Department. In this connection, Mr. Alfred Mansfield, who has been advising the Corporation all through, has made the following suggestions for completing the scheme for the lighting of the city.

1.—A general survey of the public lights in Calcutta should be made, and instructions given for the alteration of their positions when they are found to be on one side of the road only.

2.—The positions of some of the lights do not appear to have been selected with due regard to efficiency and economy, and should be altered.

3.—Each lamp should be provided with a consecutive number. This is very important, in order to make sure of the correct number in use, and to identify lamps readily.

4.—In my opinion, a plan should be prepared, to a large scale, showing the positions and consecutive numbers of all the public lights in Calcutta. As it is probable that lights of different powers will be used, it will be convenient to indicate these by several circles, one inside the other, or by some other convenient method. For instance, a 40-candle power light might be indicated by one circle, a 60-candle power light by two circles, &c.

5.—A general survey of the pressures at all points should then be taken during the hours of public lighting, and when the private consumption is heaviest, in order to ascertain the minimum pressure which may be expected at any lamp. These pressures should be marked on the plan in different colours; so that, when completed, the whole plan will show at a glance any unevenness of pressure. If on completion the plan is not found to be satisfactory, owing to great unevenness of pressure, steps should be taken to insist on the Gas Company using every endeavour to distribute the pressure evenly. I need hardly point out that this work must be entrusted to someone who has an intimate knowledge of the subject, and who can make certain that the pressure at the gas-works, or conditions which occur owing to fluctuations of private lights, do not lead him into recording incorrect pressures. It is reasonable to expect that no pressure will be higher than 3 inches; and in accordance with the terms of the contract no pressure must be less than 2 inches.

6.—I recommend that pressures should be taken to the nearest tenth of an inch; a separate colour being used on the plan for (say) each tenth of an inch between 2 and 3 inches. When a final plan has been prepared and agreed to by the Gas Company, these pressures will be accepted as pressures it is possible to maintain for an extended period and at which tests of the consumptions of nipples will be made.

7.—Having finally settled the plan of pressures, the next step is to ensure that these pressures are maintained. For this purpose, positions must be selected for fixing recording pressure-gauges to the best advantage. This will necessitate some careful consideration. Each recording pressure-gauge should be an index of the pressure of a considerable number of lamps. For instance, it will be found that a pressure-recorder fixed in a certain position indicating a pressure of 2½ inches shows that every lamp within a certain area is getting not less than 2 inches. If nipples are tested and gas paid for at these pressures, care must be taken that the penalties are exacted for any fall of pressure on the recorder below 2½ inches. A table of penalties will be prepared in connection with each pressure-recorder. For the convenience of the Accounts Department, the effect of a reduction of pressure by each tenth of an inch at each pressure-recorder would be converted into rupees for the purpose of recovering penalties due from the Gas Company.

8.—It is proposed to provide and fix 8000 new lanterns in Calcutta. Tenders for these were advertised for in England, and estimates and samples by the leading lamp makers are now in Calcutta. A selection from these should be made, as soon as possible, in order to ensure their erection in time for the new contract.

9.—The selection of suitable burners is a most important matter. Tenders were advertised for in England; and samples and quotations from leading manufacturers are now in Calcutta. These should be tested in the new gas testing laboratory, which is now complete. The Gas Committee can then decide the size and type of burners which will be used in the various positions in Calcutta.

10.—After all these preliminary arrangements have been made, it will be necessary to consider who will be responsible for the faithful carrying out of the whole scheme. This should fall to the lot of a Lighting Department. It is necessary to decide whether this department will be entrusted to the Gas Company, as in the past, or whether it will be advisable to establish a Municipal Lighting Department, as is done in England. It must be remembered that, even if you decide to entrust the Lighting Department to the Gas Company, it will still be necessary to maintain a certain staff to ensure the due fulfilment of the terms of the contract, both in the laboratory and outside. The present and past lighting of Calcutta, as carried out by the Gas Company, will not, I think, encourage you to hope for anything better in the future. Unless they can prove to your satisfaction that they will provide a much better staff, and system, for this important work than in the past, I do not think that you have any alternative but a Lighting Department.

11.—Should you decide to establish such a department, I think you will find the following of interest. I have endeavoured to give figures for each item which are in excess of the actual requirements.

12.—The items to be considered in connection with the public lighting of Calcutta are as follows: A.—The supply of 9000 new lanterns. B.—The cost of painting and repairing lanterns and posts. C.—The supply of burners and replacements. D.—The cost of lighting, extinguishing, and cleaning lamps. E.—The cost of renewing mantles, rods, and chimneys. F.—The cost of supervision and establishment. G.—The cost of gas.

Item A.—In their original tender, it was thought that the Gas Company agreed to supply 9000 new lanterns each costing Rs. 55 if the contract was arranged for twenty years; but I now think that this was not the case in their reduced tender. I suggested, and you have agreed, that it is not necessary to provide more than 3000 lanterns at present. The remainder can be replaced in the future. I proposed, however, to assume that all the 9000 lanterns will be changed at once, as this will show the estimate in the most unfavourable light. The cost of the new lanterns and burners, according to the quotations and samples now with you, should not exceed Rs. 40 each, and Rs. 3,60,000 for the 9000 lanterns. Interest and sinking fund at 5 per cent. will require an annual payment of Rs. 18,000 under this head.

Item B.—The cost of painting and repairing the lamp-posts and lanterns will be amply met by an allowance of Rs. 1-8 per annum for each light, or a total of Rs. 13,500 per annum.

Item C.—The cost of burners will probably be between Rs. 2 and Rs. 3 each. In order to allow an ample margin, I propose to allow twelve annas per light per annum for depreciation of burners, or a total of Rs. 6750 per annum.

Item D.—This item consists chiefly of labour; but a small amount must be added for materials for lighting and cleaning. The number of lamps which a man can light and extinguish is generally controlled by the time allowed for lighting. This is about an hour. Lamplighters in England light, clean, and extinguish and exchange mantles in from 90 to 120 lamps. I propose, however, to fix an average of 50 lights for each lamplighter. In addition to this, I suggest that you provide ten special men whose sole duty shall be the renewal of mantles. As each mantle is calculated to last for one month, each man will replace 900 mantles per month. The pay of the lamplighters I suggest should be an average of Rs. 12 per month each, and that of the mantle renewers Rs. 20 per month each. There would be 180 lamplighters required, and (say) 10 extra men in case of sickness. The cost of Item D would therefore be as follows: 190 lamplighters at Rs. 12 per month, Rs. 2280; 10 mantle renewers at Rs. 20, Rs. 200; materials for lighting, &c., (say) Rs. 50—total cost of Item D per month, Rs. 2530; total cost per annum, Rs. 30,360.

Item E.—The cost of mantles, mantle-rods, and glassware is dependent on the quality. The mantles at present used by the Gas Company are of inferior quality, and can be supplied to you at half the cost I propose to allow in this estimate. The Gas Company state that the average life of their mantles is one month. The better quality mantle will have a longer life; but I propose to allow one mantle per month, or Rs. 3·12 per annum, for each light for renewal of mantles, mantle-rods, and glassware—or a total of Rs. 33,750 per annum.

Item F.—I suggest that the lighting area be divided into four sections, each having its headquarters at the district offices of the Corporation. There should be four overseers at Rs. 60 per month each, and four supervisors at Rs. 150 per month each. These men will be responsible for the supervision of the lamplighters, the issuing of new mantles, and receipt of old mantles (which are worth Rs. 7-8 per pound), the care of pressure-recorders, &c. It will also be necessary to place a capable man in charge of the laboratory, who will make tests and see the conditions of the contract are faithfully fulfilled. In addition to this, he must be capable of undertaking outdoor work, the general supervision of the lighting, and the tabulating of all the records and accounts from the various districts. This laboratory assistant must be a superior well-paid man. In addition to this, it is advisable that supreme charge should be given to a responsible official of the Corporation. He should be familiar with instruments of precision, and have had experience in laboratory work. He should be able to understand and appreciate the difficulties of distributing gas over an extended area, and rigidly enforce the penalty clauses of the contract when desirable. Your Chief Engineer (Mr. MacCabe), who has been associated with me in all my work in connection with the new contract, is, in my opinion, eminently capable of undertaking this work. He has an excellent knowledge of the subject, and is skilful in the laboratory. As it is probable you will desire to debit the Lighting Department with a portion of this official's salary, I propose to make an allowance for the official, laboratory assistant, and expenses, of Rs. 15,000 per annum. In order that you may be satisfied that the whole department is working in the most efficient manner, that records are being accurately kept, instruments in perfect order, lights working at their best, and no excess of gas being paid for, I suggest that you should allow a sum of 100 guineas per annum for the fee of an independent expert to investigate and report fully once a year on the working of the whole system. The total cost of this item will therefore be: Four overseers at Rs. 60 per month, Rs. 2880; four supervisors at Rs. 150 per month, Rs. 7200; proportion of official's salary, for laboratory assistant, &c., Rs. 15,000; expert report, Rs. 1525—total Rs. 26,605.

Item G.—In arranging the burners for the lighting of Calcutta, I suggest that the average consumption should be 3½ cubic feet per hour. This is the quantity which is considered reasonable in English towns. The total consumption of 9000 lights burning for 3914 hours per annum each, consuming on an average 3½ cubic feet per hour, would be 123,291,000 cubic feet, which, at Rs. 2·8 per 1000 cubic feet, would cost Rs. 3,08,227-8.

SUMMARY.

The total cost of lighting Calcutta in the liberal manner I have now described will therefore be as follows: Item A.—New lanterns, Rs. 18,000. Item B.—Painting and repairs, Rs. 13,500. Item C.—New burners, Rs. 6750. Item D.—Lighting, cleaning, and extinguishing, Rs. 30,360. Item E.—Mantles, mantle-rods, and glasses, Rs. 33,750. Item F.—Supervision and establishment, Rs. 26,605. Item G.—Cost of gas, Rs. 3,80,227. Total, Rs. 4,37,192.

In connection with this subject, I asked the Directors of the Oriental Gas Company to quote their price for lighting, cleaning, and extinguishing the lamps. They stated in a letter dated Sept. 7, 1909, and addressed to me in England, that their price would be annas 12 per lamp per month. I asked whether a lamp meant a single light, as in some cases there were two lights to each lamp. They replied that their price would be annas 12 per lamp whether single or double lights, provided the Corporation would exempt them from payment of municipal rates and taxes. I do not think that you will entertain such an offer, because annas 12 per light per month, or Rs. 9 per light per annum, for 9000 lights would amount to Rs. 81,000 per annum for Item D only. This compares very unfavourably with the price at which I estimate the Corporation can do the work in a much more efficient manner.

In a note appended to this report, by the Chairman of the Special Gas Committee, some slight modifications of the scheme are suggested, as the result of which the cost would work out as follows.

Non-Recurring Expenditure.—First year, 3000 lanterns, Rs. 1,20,000. The following six years, 1000 lanterns a year, Rs. 40,000 a year, Rs. 2,40,000. Total, Rs. 3,60,000.

Recurring Expenditure.—B.—Painting and repairing, Rs. 13,500. C.—New burners, Rs. 6750. D.—Lighting, cleaning, and extinguishing, Rs. 31,800. E.—Mantles, mantle-rods, and glasses, Rs. 33,750. F.—Supervision and establishment, Rs. 27,655. G.—Cost of gas, Rs. 3,08,227. Total, Rs. 4,21,682.

SMOKELESS FUEL IN GLASGOW.

At a Meeting of the Gas Committee of the Corporation of Glasgow on Friday, Dec. 24, there were submitted for inspection two samples of coke, the results of recent experiments at the gas-works in connection with the production of a smokeless fuel for domestic purposes. The nature of the samples was explained by Mr. A. Wilson, the Gas Engineer. One was that of coke which had been treated with certain chemicals in the retort. The use of these chemicals, it was stated, improved the quality of the coke, and made it more suitable for household use, as it kindled quickly, and no clinker was formed. The other sample was ordinary coke which had been cooled without the application of water. It had been tested in an ordinary fire, and was found to kindle easily, with the customary incentive of sticks and paper. It burned brightly, yet without flame, and sent out a good, radiating heat. It is believed that the use of coke such as both experiments produced would do much to mitigate the black smoke nuisance.

The Gas Committee viewed the results of the experiments with much interest, and agreed to remit to a Sub-Committee and the General Manager to inquire into, and report on, any process of gas making which would produce a form of coal residue that might be available for use in ordinary domestic grates.

The Committee also agreed to a proposal that a Committee be appointed to arrange for a series of lectures in various halls throughout the city, for the purpose of demonstrating what can be attained by the most recent and improved appliances for the utilization of gas for domestic lighting and cooking.

AN AMALGAMATION CELEBRATION.

Gaslight and Coke—West Ham Concert.

On Saturday evening, the amalgamation of the West Ham Gas Company with the Gaslight and Coke Company was appropriately commemorated by a concert which was given by the combined prize bands of the Kilburn Branch of the Gaslight and Coke Company and of the West Ham Gas-Works. The chosen spot was the Bow and Bromley Institute, in Bow Road, just on the border of the West Ham district; and there a large audience assembled to enjoy an excellent programme of music, song, and recitation, which was rendered in a manner that elicited warm praise from all present. The Chairman was Mr. D. Milne Watson, the General Manager of the Gaslight and Coke Company; and the Vice-Chairman, Mr. A. G. Snelgrove, who has for long past occupied the position of Secretary of the West Ham Gas Company. They were supported by a number of other officials of the two undertakings. During the evening, short addresses were delivered by the Chairman and the Vice-Chairman. To the many good features of the concert it is unfortunately impossible specially to refer here; but some of the points made by Mr. Milne Watson and Mr. Snelgrove, in the course of their remarks, are given below.

Mr. Milne Watson, who was received with loud applause, remarked that it gave him great pleasure to be present on such a pleasant occasion. It was quite possible that a good many people down West Ham way had, in a sense, been dreading the coming of the Gaslight and Coke Company; but he trusted they had found the "marriage-day" not nearly so bad after all. It seemed to him a good augury for the future that the two bands had that evening played so harmoniously together. They were assembled in the hall to celebrate the coming together of these two important Companies; and he hoped it would prove to be the beginning of a very long and happy career of usefulness together. The Gaslight and Coke Company were coming down to the East End of London with every good wish for the officials and workmen of the West Ham undertaking who were joining them that day. It appeared to him that the most important thing for them all was to forget as soon as possible that they were West Ham or Gaslight and Coke—to thrust from their minds, as it were, all thought of their origin. This, he believed, would be the best way of continuing their work of fighting the common enemy. There were some things in which, no doubt, the Gaslight and Coke Company could help the West Ham officers and men. There was a Rifle Club, at which anyone from the Stratford works would certainly be most heartily welcomed. It was hoped soon to have a similar club at Stratford. Then there were allotments at Bromley, some of which would be available for men who had been in the employ of the West Ham Gas Company. In these little ways it was the desire of the Gaslight and Coke Company to show their perfect friendliness towards their new comrades. If this feeling was sincerely shared by each individual officer and man, he was convinced that they would all march triumphantly forward. He regretted that not all the old West Ham officials were coming into the amalgamated undertaking. Mr. Snelgrove, for instance, was not coming with them. He had grown grey in the service of the West Ham Company, and would be missed. They heartily wished him long life and prosperity in his retirement. There were also others who were not coming along with them—Mr. Wright, Mr. Gwinn, Mr. Madge, Mr. Clark, and Mr. Lethbridge. These gentlemen carried away with them the best wishes of all who were connected with the combined undertaking. In conclusion, he assured those present that a strong forward policy would be pursued; and he was certain that if the amalgamation so auspiciously celebrated that day was worked on right lines—all going hand in hand together—it would prove to be the opening of a bright day for officers and men, as well as for the combined undertaking for which they worked.

Mr. Snelgrove, who was also enthusiastically greeted, remarked that the previous speaker had already said some of the things which he himself had intended to say. He must first of all thank Mr. Milne Watson on behalf of the retiring staff of the West Ham Gas Company for the extremely nice way in which he had spoken of them. But he thanked him more still for the kindly words with regard to the future. He himself had no doubt of the complete welding together which would take place. Mr. Milne Watson had told them what the feelings of the Gaslight and Coke Company were; and he (the speaker) was sure that their intentions were just as they had been represented to be, and that they desired all distinction between the two undertakings to disappear. The West Ham men would not be backward in accepting this position. He himself had no doubt whatever of the real sincerity of the sentiments they had heard expressed that evening; and he was sure the men had none. There would in the future be the happiest feelings among the employees of the combined undertaking. There would be no separate distinctions, but simply one entity; and Mr. Milne Watson would have the satisfaction of knowing that he had very largely contributed to this. He thanked him for coming down to the Institute with his distinguished staff, and inaugurating in their midst the new condition of affairs. The hall in which they were assembled was practically speaking in West Ham. He did not know who originated the idea of having the concert; but whoever was the author, it was an extremely happy one. He took it that the concert and the harmony which had prevailed that evening between the two combining forces were merely a forecast of what would be the actual state of affairs in the future. They had seen how well, in concert and in harmony, the men could play; and he was perfectly satisfied they would work in concert and harmony equally well.

Maryport Water Scheme.—The Maryport Urban District Council have let the contract for their new water scheme to Messrs. Bushby and Sons, of Leeds, whose tender—£10,586—was the lowest. The works are supplementary to the present pumping scheme, and include an additional pipe from the River Derwent at Cockermouth. The original estimate of the total outlay was £17,000; but now it is considered that £13,000 will cover the cost, including land. Local labour must be employed.

ELECTRIC LIGHTING IN DUBLIN.

Losses on the Scheme—Warning by the City Treasurer.

In a report on the Dublin electric lighting scheme which was to come before the Corporation at their meeting yesterday, the Electric Lighting Committee announced the necessity of bringing again before the Council the question of the deficit in the electricity undertaking, and the advisability of, at least slightly, increasing the rates of charge. An increase of 10 per cent. on current supplies for lighting purposes was proposed; this being estimated to bring in £3500 additional per annum—the increase to take effect from the 31st of March next.

A letter from the City Treasurer (Mr. E. W. Eyre) was appended to the report. He gives it as his opinion that the increase should be at least ½d. per unit. The loss involved in the general change by consumers from the old carbon to the new metallic filament lamps is estimated at £15,000 at least. The Committee stated that they did not consider that a small increase in the charge would materially influence the growth of consumers, the number of which on Dec. 15, 1908, was 2080, and on Dec. 15, 1909, 2570. This increase (the Committee stated) would have gone a considerable way towards removing the loss in working, and possibly have cleared off the loss altogether, but for the fact that this year nearly all the consumers who had continued to use the old style of lamp changed to the new metallic filament lamps (which are now in almost general use), and the income derived from these consumers has decreased to a very large extent. As a result, the Committee expressed regret that they could not anticipate that the working of the undertaking for the year ending the 31st of March next could be carried through without some charge on the rates; and they asked for the opinion of the Council on the question of the increase in the charge for current.

In the letter above alluded to, Mr. Eyre refers to his earlier report on the subject (given in the "JOURNAL" for Feb. 16 last), in which he says it was clearly shown that current was being sold at less than the average cost of manufacture, when the capital charges were included. This report, for reasons which Mr. Eyre gives, was not fruitful of results; and the concern is still being run at a loss. There is not provision for renewals or depreciation, and the bank overdraft (now amounting to upwards of £43,000) continues to increase. Mr. Eyre proceeds: "I must now, for my own protection, protest against a deliberate course of action which involves a continued indifference to that liability. If your Committee cannot induce the Council to approve of a readjustment of your lighting charges, so as to provide at least for the wiping-out of this debt, I will be forced into the position, for my own safety, of refusing to allow the Committee any longer to avail themselves of the circumstances of existing credit balances on other accounts as a means of carrying on the undertaking, especially in view of the facts and figures set out in report No. 34, and particularly in view of the circumstance that your Committee itself agreed as to the absolute necessity of an increase in price for current."

PROPOSED WATER BOARD FOR RHYMNEY VALLEY.

Conference of Local Authorities.

A Conference of Delegates from the District Councils on the Glamorganshire and Monmouthshire sides of Rhymney Valley was recently held at the offices of the Gelligaer Urban District Council, to consider a proposal for the formation of a Joint Water Board. When the Glamorgan Water Bill was before Parliament in the past session, it was intimated that the Rhymney Valley would be excluded from its operations; but the opinion was expressed that, owing to the complex character of the valley, it was imperative that a Water Board should be formed to control the district. It may be remembered that the Bill was rejected; but, in view of the expression of opinion above referred to, the Caerphilly District Council took the initiative by convening a meeting of the several authorities so as to discuss the whole situation, especially in relation to the Rhymney and Aber Valleys Gas and Water Company and the New Tredegar Gas and Water Company on their respective sides of the valley. Places represented were Caerphilly, Gelligaer, Bedwellty, Mynyddislwyn, St. Mellons, and Rhymney. Mr. C. S. GOODFELLOW (Caerphilly) was chosen to preside.

The CHAIRMAN, in opening the proceedings, said the question of the necessity for the formation of a Joint Water Board had been mooted throughout the valley for a considerable time; and it was now generally agreed among the authorities that one should be established. They in the lower end of the valley had suffered, as no doubt the other parts had done, from want of a sufficient supply of water; and the formation of the valley lent itself to the establishment of an ideal Water Board. There were a number of instances where these Boards had worked successfully; so that the technical management of such an organization could be followed on somewhat similar lines. The first thing to ascertain, however, was the opinion of the several authorities in the district; and in order to do this, he would ask for a resolution. If anyone was prepared to move one, an amendment could be submitted, and by this means a discussion could be opened. If the Board was formed, the present Company (Rhymney and Aber Valleys Company) would have to be bought out.

Rev. T. JESSE JONES (Gelligaer) said the first fact was that at the present time the valley had not a proper water supply. The monopoly of the supply was in the hands of the Rhymney and Aber Valleys Gas and Water Company, who were under statutory obligations to construct a reservoir; and the only penalty for the non-fulfilment of this obligation was that their powers would cease. He did not think the Company had started this work yet; and he did not know that the local authorities had taken any steps to see that it was done. It was the duty of the District Councils to urge upon the Company to meet their statutory obligations. He believed they were honestly striving to do their duty; and he must say that they were improving their service. With reference to the water companies in the valley, he took it that the different Councils would jointly be in the position of a party in treaty with them, and would ask them if they wished to sell their

undertakings. If so, they would have to state their terms. The companies would reasonably look into the future, and could reasonably expect a great improvement in their financial position. At the same time he would not be a party to paying anything to cover such prospective improvements, but would take the value of the Company's assets with interest. In a matter of this kind, it would be unfair to expect the Rhymney and Aber Valleys or the New Tredegar Companies to give up the rights that they now held without some consideration for them; but, having regard to their own interests, would it be fair or reasonable to pay upon the prospective value of their undertakings? The magnitude of the question before them was such that they should consider it from all points.

Mr. W. S. NASH (Mynyddislwyn) said if the proposed Water Board were formed, and the monopoly of the supply of water transferred to them, it seemed to him that the larger District Councils in the valley, who would have to pay the greater proportion of the purchase money, should control the scheme. The Mynyddislwyn district had but a small portion of their area in the proposed watershed, and therefore could not really claim the same interest in the Board as the larger and more responsible districts. He felt, as he always had done, that the water supply should be in the hands of the local authorities. The longer the purchase was delayed, the greater would be the amount they would have to pay; and therefore the sooner the supply was transferred the better it would be all round.

Mr. HUBERT JENKINS (Caerphilly) said his Council were prepared to go on with the Joint Board scheme, and he had a mandate to this effect. He thought if the members present would go back to their Councils with a strong recommendation that the Board should be formed, there would be no difficulty about the matter.

After some further remarks, it was decided that the representatives should recommend their authorities to approve of the formation of a Water Board; and that the next conference should be held the first Thursday in February.

POCKET-BOOKS, CALENDARS, &c.

Since penning the acknowledgments under this heading which appeared in last week's "JOURNAL," we have received an attractive fancy casting in the shape of a combined match-box holder and ash-tray, made at Messrs. Thomas Glover and Co.'s and Messrs. R. & A. Main's Gothic Works, Edmonton. From Messrs. Drakes, of Halifax, there is an ingeniously contrived inkstand, in a form which renders it particularly suitable for the desk of a gas engineer—that is to say, it is an excellently modelled retort-mouthpiece. Messrs. F. C. Sugden and Co., of East Parade, Leeds, forward one of their neatly arranged pocket diaries for 1910, with £1000 accident insurance coupon. In addition to general information, notes are given on the construction of the firm's various types of settings; and there is a description of the Hudson patent producer, as applied thereto. Mr. Henry Thomas, of Mawson Chambers, Manchester, sends a compact calendar, in white and gold, which slips into a case, for the waistcoat pocket. A large wall calendar is to hand from the Economical Gas Apparatus Construction Company, of No. 19, Abingdon Street, S.W.; and a tear-off date block, with exceptionally bold figures, from Messrs. Simon-Carvès, Limited, of No. 20, Mount Street, Manchester. A wall-calendar from Messrs. George Glover and Co., of Chelsea, is an artistic production which will be an ornament to any room. Mr. A. C. Scriviner, of Birmingham, has a desk calender, with monthly changeable cards.

Early Days of Gas in New York.

The number of our American contemporary "Gas Logic" for the past month contains some reminiscences by Dr. Thomas Hunter, who was Principal of an important Grammar School in New York from 1850 to 1869. He went to America from Ireland in 1846; and he says it was in Dublin that he first saw gas used for purposes of illumination. Referring to its employment in New York, he says it was introduced gradually and at different periods; it was not general until after its superiority to the oil-lamps caused it to supplant them altogether. The principal streets were lighted with it almost uniformly in 1851; but the lamp-posts were not so close together as they are now. It was not deemed necessary to have all the streets lighted exclusively by gas; and it was not at all uncommon to find the gas-lamps alternated with oil-lamps in the side streets. When the schoolhouse was first built, in 1846 or 1847, oil-lamps and candles were used when a particularly dark day made it necessary to light up; but when Dr. Hunter became a teacher, these primitive methods had to give way to gas. In the days referred to by him, the total number of inhabitants of old New York was not within 150,000 of the number of consumers now supplied with gas. "Light is the great humanizer," says Dr. Hunter; "and the light supplied by gas is one of the most important factors in our civilization."

Fatal Gas Escape at Smethwick.—Ida Parkes, a twelve-year old girl, who was staying with a married sister, met with her death under sad circumstances just before Christmas. At the inquest, the brother-in-law stated that when he went to her bedroom to wake her, she was lying over the side of the bed, with her head almost touching the floor. He did not think he was affected by the gas-fumes, neither was his wife. There was a gas-bracket in the child's room; but this was turned off, and the bedroom door was also open. Benjamin Skidmore, an Inspector in the employ of the Smethwick Corporation Gas Department, said when he got to the house he found the gas had been turned off at the meter; but there was a distinct smell of stale gas. The fittings and pipes were in good condition, with one exception. He found there was a split in the pipe of the hall-lamp about an inch in extent. From this there would probably be an escape of gas of from 15 to 20 feet per hour. Dr. Pitt said when he was called to see the child she was dead. He thought that more gas must have found its way into her bedroom than into the room of the other people. The girl apparently tried to get out of bed at a time when she was too far gone; and she collapsed. The Jury returned a verdict of "Accidentally poisoned by gas."

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Though the incidence of the Christmas holiday, and, I suppose, the difficulties of the Post Office in grappling with their vast business at the season, led to my inability to furnish you with a few notes upon some events which marked the course of the gas industry in Scotland in the year 1909, it may not be out of place that I should now put down some random thoughts upon the subject. There is nothing of a very outstanding nature to chronicle. Perhaps one of the most satisfactory features in the year's working was that in the early summer, when coal contracts were being entered into, the market was easier than it had been before or than it is now, with the consequence that supplies were obtained at rates which have allowed of a general reduction in the price of gas. Large reductions have not been the rule, having been in most instances only 1d. per 1000 cubic feet. In Glasgow, the reduction made was from 2s. 1d. to 2s.; in Dundee, from 2s. 4d. to 2s. 3d.; in Aberdeen, from 2s. 7d. to 2s. 6d.; in Alloa, from 2s. 2d. to 2s. 1d.; and in Dumfries, from 2s. 11d. to 2s. 10d. In Arbroath, the reduction was from 2s. 11d. to 2s. 8½d.; in Hamilton, from 2s. 1d. to 1s. 10½d.; in Edinburgh and Broughty Ferry, from 3s. to 2s. 10d.; and in Stirling, from 2s. 10d. to 2s. 6d. Outputs of gas have been well maintained. In 1908, the climatic conditions were very much better than last year; and for this reason chiefly, with perhaps the circumstance that there had been an enormous extension of incandescent gas lighting, the outputs that year were in many cases adversely affected. The dull and cold weather in 1909 led to an augmented demand for gas; so that the year compares very favourably with its immediate predecessor in the matter of gas consumption. This aspect of the year's working was, too, greatly affected by the fact that on two occasions, in November and December, there were dense fogs, particularly in the West of Scotland, during which there was a very greatly increased demand for gas in quite a number of places. But these local experiences, welcome in themselves, do not displace the fact that, all over, there has been an advance in the gas consumption, pointing to the conclusion that the loss of output consequent upon the advent of the incandescent burner has touched bottom, and that normal increases may now be looked for from year to year.

Entirely new gas-works were opened at Kennoway in March; at Cardenden, in July; and at Fauldhouse, in August. Gas-works extensions to be noted consisted of a new 400,000 cubic feet gasholder, which was inaugurated at Arbroath in September; and a new gasholder of 150,000 cubic feet capacity, which was inaugurated at Burntisland in November.

The joint-stock companies formed last year were five in number—Lochmaben, in February; Fraserburgh, in April; and Cove and Kilcreggan last week, to take over existing Companies; and Cardenden in February and Fauldhouse in March, which were both new concerns. During the year, Provisional Orders were obtained by the Coatbridge Gas Company and the Musselburgh Gas Company, both already incorporated Companies, authorizing them, among other things, to reduce the illuminating power of their gas—in the case of the former from 20 to 15 candles, and in that of the latter from 22 to 14 candles.

Notices of application for Provisional Orders have been given by the Corporation of Glasgow, who are seeking to have their Gas Acts consolidated; and by the Corporation of Kirkcaldy, who wish further powers than are conferred by the General Acts, after they have acquired the undertaking. For the purpose of promoting transfer of gas undertakings, the Burghs Gas Supply (Scotland) Act was adopted by the Corporation of Kirkcaldy, in May; by the Corporation of Carnoustie, in July; and by the Corporation of Fraserburgh, in September. At Stonehaven, the other day, a Committee of the Town Council was appointed to endeavour to ascertain on what terms the Gas Company would sell their undertaking. A similar Committee was appointed by the Town Council of Markinch in May.

Changes in *personnel* have been somewhat numerous. Mr. W. Bartholomew, the Manager of the Ochiltree Gas-Works, died in January, from the effects of an accident he sustained within the works; Mr. G. Malan, of Dumfries, died in April; and Mr. John P. Scott, of Bridge of Allan, died in August. Mr. A. Bell, sen., retired from the managership at Dalkeith early in the year; Mr. W. M'Lean Ross resigned the managership at Stonehaven in May, on account of his having received an appointment in Australia; and in July, Mr. A. Robertson resigned at Alyth. Mr. R. W. Cowie, of Lockerbie, was appointed Manager at Dalkeith in March; in May, Messrs. J. Smith and S. Dickie were appointed Joint Managers at Dumfries; in June, Mr. W. Fred Vernon, of Coupar Angus, was appointed to Stonehaven; Mr. W. Brown was appointed Manager of the new Company at Cardenden, his place at Lasswade passing to Mr. J. Macmillan, of Lochgilphead. Mr. S. M'Lusky was appointed to fill the vacancy at Coupar Angus; Mr. A. Watt, of Banchory, was appointed to Alyth; and Mr. Gavin Muir, of Stonehouse, was appointed Manager of the Neilston Gas Company.

A meeting of the Edinburgh and Leith Gas Commissioners was held on Monday, at which, among other matters of interest, it was intimated that the Commissioners have resolved to apply to the Board of Trade for arbitration with respect to the increased rates and charges proposed by the railway companies to be exacted in terms of their circular of Aug. 1, 1908. The Commissioners had before them the important document, given on another page, relating to the charge for gas sold by means of prepayment meters. No resolution was arrived at on the subject; there being evidently a desire on the part of some of the Commissioners to break down Mr. Herring's resolution to maintain the existing extra charge of 1s. 2d. per 1000 cubic feet. There is a tendency in many towns, on the part of some councillors, to pander to the least desirable class of gas consumers. Mr. Herring is not on that side of opinion; and the position he has taken up will help to strengthen those who think sanely on the subject.

Another document of supreme importance sees the light this week, in the report by Glasgow Corporation officials upon the effect on the atmosphere of the use of gas-stoves in dwelling-houses. A perusal of this document shows how thorough the inquiry was. The conclusions arrived at will be commensurately valuable. The publication of this

report will give impetus to a movement which is taking shape in other places than in Glasgow.

The Corporation of Glasgow are already moving in the matter of air purification, having recently passed a resolution which asked the heads of municipal departments to consider how far it would be possible to use smokeless fuel in the public service. The replies of the heads of departments have now been given. Mr. F. W. Harris, the Corporation Chemist, states that he could with advantage substitute gas-fires for coal-fires. Mr. W. C. Menzies, of the City Improvement Department, reports that he has been experimenting with coke as fuel, and is now burning it in a number of places under his charge; and that he is endeavouring to get gas-fires installed in some Corporation property. Mr. D. M'Coll, the Cleansing Superintendent, found that in office fires ordinary coke gave off sulphurous fumes, which rendered it quite unsuitable. Malting coke, which could be bought for 19s. per ton, was fairly suitable. Anthracite coal was of little use for heating a room. Mr. A. Wilson, the Gas Engineer, considers that there would be no difficulty in substituting gas-fires of a thoroughly satisfactory description for coal-fires in his department; but before this should be done, he proposes to make experiments with gas-works coke, treated in a special manner to make it suitable for household purposes. Mr. S. B. Langlands, the Lighting Inspector, reports that he has nine gas-fires and 38 coal-fires in his department. He is replacing some of the coal-fires with gas-fires, and considers that he can extend this throughout all the offices without an unreasonable increase in the cost. Mr. Thomas Nisbet, the Master of Works, as the result of trials he has been making in connection with road-rollers, expects that in future he will be able to arrange that more coke and less coal shall be used. Mr. T. Melvin, of the Sewage Department, suggests the use of anthracite coal in his department. Mr. C. M'Donald, of the Weights and Measures Department, suggests that generally gas-fires should be substituted for coal-fires. Mr. W. W. Lachie, the Electrical Engineer, states that in his department there is only one coal-fire, for which a radiator could easily be substituted. The offices are heated by hot-water apparatus, in which 62 tons of coke are burned yearly. In their generating stations, about 84,000 tons of coal are burned yearly; and no other form of fuel could be in the meantime substituted for coal. The Air Purification Committee have resolved to have the replies of the officials printed before they take up consideration of the subject.

The Gas Committee of the Dundee Town Council on Tuesday considered a proposal that application should be made for an increase in the borrowing powers connected with the gas undertaking. The proposal was explained by Mr. Soutar, the Corporation Treasurer. The Gas Department, he said, was never in a more satisfactory state, or under better management. Their present borrowing power was £400,000; but they had over-borrowed to the amount of £25,960. Looking forward in a business-like way, with a sound degree of discretion and prudence, it had become evident to Mr. Yuill—and he thought there was no more competent manager in Scotland than he—and to the Gas Treasurer, Mr. Burke, that they must have additional borrowing powers to meet the estimated capital expenditure on works during the next ten years. Up till 1920, it was estimated there would be spent on works an amount of £120,000; and it was for this sum they thought it advisable to get additional borrowing powers. Against the amount which they wanted power to borrow, they had a book value of works of £443,031, and a marketable value, as calculated by Mr. Yuill, of £796,746, which, on a make of 875,347,000 cubic feet of gas per annum, equalled a capital expenditure of £908 per million cubic feet of gas delivered. When the gas-works were taken over in 1869, this figure stood at £1278. Lord Provost Urquhart said he had been in the complacent belief that their gas-works were up to date, and that their large capital expenditure had really come to an end. He was therefore surprised at the proposal, and thought the matter should be remitted to a Committee to consider. This course was unanimously agreed to.

The deputation from the Dumfries Town Council which was recently appointed to visit the gas-works at Stirling, Falkirk, and Kilmarnock, with a view to advising upon the proposal to reconstruct the retort-house and coal-store, and to introduce mechanical stoking, at an estimated cost of about £11,000, have prepared their report, which is favourable to the proposal. All the managers, they state, when questioned as to manual labour, stated that stoking by machinery was the more economical method of manufacture. The increase of profits might be placed at from £1500 to £2000 per annum. From the apparatus seen and the results given, the deputation are certain that by the reconstruction of the retort-house and coal-store an increased saving may be annually obtained, as well as a considerable reduction in the price of gas.

The Lochwinnoch Gas Company have paid a dividend of 4 per cent., free of income-tax, for the year 1908-09.

In the beginning of September, it was intimated that the Inverkeithing Gaslight Company were contemplating the extension of their works, and that the Town Council had taken up the consideration of the question of acquiring the Company's undertaking. It would seem, from what transpired at the annual meeting of the Company on Thursday, as if nothing is to come of the proposal for a transfer. The Directors recommended payment of a dividend of 6¼ per cent., free of income-tax. They pointed out that during the year 324 tons of coal were carbonized, and 2,442,100 cubic feet of gas produced; these figures being records in the history of the Company. After the ordinary meeting, an extraordinary general meeting of the shareholders was held, at which it was reported that, in order to meet the increasing demand for gas, a feu adjoining the gas-works had been obtained, on which it had been decided to erect a gasholder of 25,000 cubic feet capacity, and to greatly extend the plant on the works, at an estimated cost of about £2000. A resolution was unanimously adopted to increase the nominal capital of the Company from £1500 to £5000, by the creation of 3500 additional shares of £1 each.

In the course of his employment at the Belfast Gas-Works, a man named Joseph Bingham was so severely burned that he had to be removed on an ambulance. It appears that his clothes caught fire from one of the furnaces.

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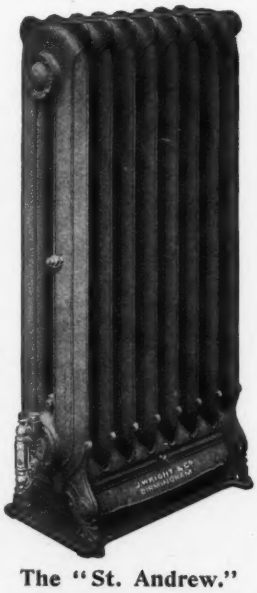

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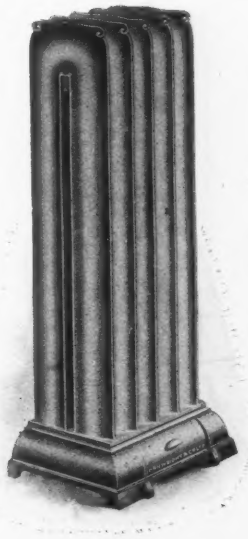

The "Official."

223.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Dec.* 31.

Sulphate of Ammonia.

In spite of the holidays, the tone of the market has been good throughout the week, and consumers have been rather more in evidence. All parcels offered by makers have found ready buyers at full prices, and at the close the position is as firm as ever; the quotations being £11 7s. 6d. per ton f.o.b. Hull, £11 10s. per ton f.o.b. Liverpool, and £11 10s. per ton f.o.b. Leith. No new business has transpired for forward delivery; but manufacturers continue to hold for £11 12s. 6d. per ton f.o.b., best ports, for January-June shipment.

Nitrate of Soda.

This article remains quietly steady at 9s. 3d. per cwt. for ordinary and 9s. 6d. for refined quality, on spot, with little business passing.

LONDON, *Jan.* 3.

Tar Products.

Markets for tar products have been firm throughout the past week. In London, there is very little offering, and several of the manufacturers appear to be well sold. On the east coast, good figures are stated to have been paid; while on the west coast business is reported at very high figures. Regarding creosote, the London manufacturers are very firm indeed, as they are particularly well sold. This is likewise the case in the Midlands and Yorkshire; and makers here can obtain good prices. In the Manchester and Liverpool districts, however, figures are low. Benzol, 90 per cent., is still very firm indeed for prompt delivery. In London there is but little available, and in the North 6d. per gallon is being freely paid. In 50-90 per cent. benzol, the position is also firm for both prompt and forward delivery. Toluol appears to be decidedly scarce. Solvent naphtha is firm in all quarters, and there is a good demand for this for near delivery. Heavy naphtha is quiet. Carbolic acid is steadier. Naphthalene is quiet; but creosote salts are in good demand.

The average values during the week were: Tar, 13s. 9d. to 17s. 9d., *ex* works. Pitch, London, 28s. 3d. to 28s. 9d.; east coast, 28s. to 28s. 6d.; west coast, 28s. to 29s. f.a.s., 28s. f.o.b. Benzol, 90 per cent., casks included, London, 6¾d. to 7d.; North, 6d.; 50-90 per cent., casks included, London, 7¼d.; North, 6¾d. to 7d. Toluol, casks included, London, 9⅜d. to 10d.; North, 9¼d. Crude naphtha, in bulk, London, 4d. to 4⅛d.; North, 3⅞d. to 4d.; solvent naphtha, casks included, London, 1s. 1½d. to 1s. 2d.; North, 1s. to 1s. 1d.; heavy naphtha, casks included, London, 11⅜d.; North, 10⅜d. to 11⅜d. Creosote, in bulk, London, 2½d. to 2⅝d.; North, 2d. to 2¼d. Heavy oils, in bulk, 2⅝d. Carbolic acid, 60 per cent., casks included, east coast, 10⅜d.; west coast, 10⅜d. Refined naphthalene, £4 10s. to £8 10s.; salts, 40s. to 45s., packages included and f.o.b. Anthracene, "A" quality, 1½d. to 1⅝d. per unit, packages included and delivered.

Sulphate of Ammonia.

This article has been firm during the past week, and prices have an upward tendency. In London, the principal Gas Companies quote £11 10s. for prompt delivery. They are practically out of the market for this period, and quote £11 12s. 6d. for January-June; while ordinary makes are quoted at £11 3s. 9d. to £11 5s. upon Beckton terms for prompt, and £11 7s. 6d. for January-June. In Hull, £11 6s. 3d. to £11 7s. 6d. is about the price, and in the Liverpool district £11 7s. 6d. to £11 8s. 9d. In Leith, £11 10s. is quoted for prompt and £11 12s. 6d. for forward. The market closes firm all round, and with a decidedly better outlook than for some time past.

COAL TRADE REPORTS.

Northern Coal Trade.

The effect of the holidays has been to reduce considerably the output of coal in the North, and also to lessen the consumption for manufacturing purposes. The shipments have, however, been limited generally, and prices have been made rather uncertain. In the steam coal trade, best Northumbrian steams are quoted at about 10s. 10d. per ton f.o.b.; second-bests, from 9s. 6d. to 9s. 10½d.; and for steam smalls, from 5s. 3d. to 6s. 6d. The production will probably be limited for a few days yet. In the gas coal trade, the demand is naturally very full at this season; but the shipments have been restricted by the cause above stated, though fair quantities have in some cases been sent out. For Durham gas coals, the current price varies according to quality—from 9s. 6d. to 11s. 3d. per ton f.o.b. for the usual classes, and up to 11s. 9d. for "Wear" specials. There is less doing in contracts; but some of the coalowners have sold a considerable part of their output over the next three months, and prefer to wait a little before making further commitments until there is more settlement as to prices and probable production at some of the collieries is more exactly defined. It is possible that the output may show a reduction at first. Coke is very firm; and gas coke, though plentiful, maintains its price at about 13s. 3d. to 13s. 6d. per ton f.o.b. for good quality.

Scotch Coal Trade.

The trade continues to be fully employed in all departments, and prices, though not higher, are firm. Forward orders are coming in satisfactorily. The collieries will be closed for a week for holidays. The prices now quoted are: Ell, 10s. to 10s. 6d. per ton f.o.b. Glasgow; splint, 10s. 6d. to 11s.; and steam, 10s. to 10s. 6d. The shipments for the week amounted to 318,827 tons—an increase of 7666 tons upon the preceding week, and of 30,044 tons upon the corresponding week. For the year, the total shipments were 15,235,969 tons—an increase of 711,132 tons upon 1908.

Best Wishes for
1910.
¶ May gas be as popular with Consumers during 1910 as our "A.B.C." gas fires have been during 1909.
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Electricity and Fire.

In a recent number of the "Municipal Journal," an article appeared on the above subject, as well as a statement by the Electricity Engineer of the Kingston Corporation, that the great fire at Clapham Junction was not due to the broken filament of an electric lamp falling upon any of the goods near it when the lamp was broken. Mr. D. H. Helps, of Reading, in a letter in the current issue, while agreeing that the filament could not have caused the fire, points out that the statements of those who were present when the lamp was broken make it clear that the fire was due to the electric fusion then set up. This fusion was, of course, not directly caused by the breaking of the globe, but by the short-circuit which occurred in the terminals of the lamp when it was forcibly struck. Mr. Helps once witnessed a similar occurrence, and he gives the following extract from a letter he wrote to the "JOURNAL" for Jan. 24, 1907: "I am writing to give a short account of an occurrence which took place in a house in which I was staying last September. This house had recently been fitted up with incandescent electric lights. A bottle was being uncorked in the dining-room, when the cork flew out and struck one of the electric lamps. The glass bulb broke, and there was immediately a blaze of light, owing apparently to the formation of an arc, which fused the brasswork of the fitting, with the result that the molten metal fell down, lighted the table-cloth, and caused other damage."

Gas Companies' Standard Burner Bill.—In accordance with the instructions of the General Purposes Committee of the Town Council, the Town Clerk of Plymouth has presented a report on the provisions of the above-named Bill; and he is to communicate with the other corporations interested to ascertain their views as to joint action being taken in the matter.

Interference with Gas-Lighting Controllers.—Mr. W. J. Couch, the Secretary of the Camborne Gas Company, has drawn the attention of the Camborne District Council to the conduct of a number of boys in the district in interfering with the working of the automatic controllers installed in the public lamps. In the cases to which particular attention was drawn by Mr. Couch, boys were seen to strike lamp-posts with pieces of iron, and kick and shake them, so as to affect the clockwork, and cause the burners to light up before the proper time. This vibration, he pointed out, not only put the clock out of order but broke the mantles, and caused irregularities in the lighting, of which complaint had been made. On the reading of the letter at the last meeting of the Council, Mr. Eddy said they ought to support the Gas Company. The Chairman (Mr. R. A. Thomas) agreed that it was a matter which could not be ignored. The Clerk, however, thought it was one which called for action by the police, and concerned the Company rather than the Council. It was pointed out that the lamp-posts were the property of the Council; and it was decided that notices should be issued warning persons against interfering with them.

Australian Artesian Borings.—An artesian boring at Woora, Western Australia, has struck a supply of 1½ million gallons of water per day at a depth of 1226 feet. Some time since, a bore was put down 15 miles north of Woora, and struck a supply of a million gallons per day at a depth of 1000 feet, while a Government bore which was put down 35 miles south of Woora obtained a supply of 2 million gallons per day at a depth of 543 feet. It is only a few years since artesian water was discovered at Carnarvon, 70 miles from Woora; and now this particular water basin is known to extend to the tertiary and recent strata, with few breaks along the coastal plains, to Perth, while a copious supply of true artesian water is also obtainable in the Collie coalfield area.

Fatal Gas Explosion.—As the result of an inquest at Dunstan on the body of Joseph Stephenson, Under-Manager at Norwood Colliery, the Jury found that the deceased died from compression on the brain, from a fracture of the base of the skull, and cerebral hemorrhage, accidentally caused by an explosion of coal gas. The explosion took place in a building in connection with the colliery office, in which there were no gas-fittings. It was stated that a smell of gas had been noticed in the roadway which passed the office, and in the vicinity of which there was a gas-main. One witness said he drew the attention of two employees of the Newcastle and Gateshead Gas Company to the escape. He remarked that there was a hollow chamber beneath the office; and the Coroner said this was an important factor, because if there was an escape the cavity would form a gasholder.

Alleged Pollution of the Exeter Water Supply.—The question of the pollution of the River Exe, to which attention was recently called by the Exeter City Council, was again considered by the Dulverton District Council at their last meeting. The Town Clerk of Exeter wrote that the Water Committee were glad to hear of the steps which the Dulverton Council were taking to abate the fouling of the river by washings from a refuse heap near the town. The City Surveyor and the City Analyst, on a recent inspection of the leat at Dulverton, had, however, found signs of pollution; and there was no doubt in their minds that there were several properties along the leat which were not connected with the sewers, and discharged raw sewage into the water. The result of an analysis of the water proved very serious pollution by raw sewage. The City Water Committee thought it was necessary that every house on the leat should be separately examined, and if not already connected with the sewers, the owners should be compelled to connect it. The Clerk of the Dulverton Council said that since the receipt of the letter he had had an interview with the Town Clerk of Exeter, and had explained that it was proposed that the Medical Officer of Health and the Surveyor should report on the subject of the alleged pollution. The former (Dr. Slade King) remarked that the Dulverton Council were not obliged to provide Exeter with a pure water supply, but they certainly were bound, under the Rivers Pollution Prevention Act, to see that sewage was not turned into the river in a crude state. He thought a thorough examination ought to be made of places where crude sewage was likely to drain into the river. Instructions were given to the Surveyor to report on the subject at a future meeting.

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TO OUR

NUMBER 5 SHOT

See "JOURNAL OF GAS LIGHTING," Nov. 23, 1909.

It is as follows:—

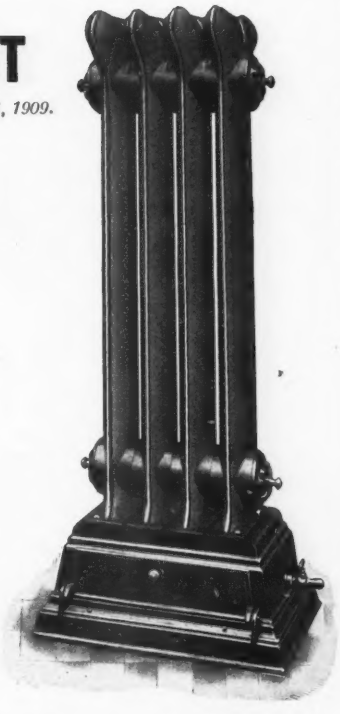
THE 'TORRID' GAS HEATED RADIATOR.

PURE HEATED AIR.

NO FUMES. NO FLUE REQUIRED.

With Trivet Door Front and Back and Copper Reflectors.

The Doors, Front and Back, can be opened, and form convenient Trivets, and at the same time, when opened, the Copper Reflector which is fitted inside becomes visible and produces a very pleasing appearance.



CANNON IRON FOUNDRIES, LTD.,

DEEPFIELDS, Near Bilston, Staffs., Eng.

London Office and Show-Rooms: 18, HOLBORN VIADUCT, E.C.

Australasian Agents: JAMES HURLL & CO., Ltd., 20, Loftus Street, SYDNEY, and Box No. 4 (G.P.O.) Dunedin.

Coalite, Limited.—The Directors of Coalite Limited announce that, in order to bring the accounts to the 31st of December in each year, the general meeting called for Dec. 30, 1909, was adjourned until March 23, 1910, when the report and accounts to the end of 1909 will be presented.

Gas Poisoning in Dundee.—On the afternoon of Sunday, the 26th ult., two women who occupied apartments at No. 30, Rose Street, Dundee, were found by neighbours lying on the floor of their dwelling in a state of unconsciousness. Two police officers applied artificial respiration while the women were being conveyed to the Royal Infirmary; and it is believed that but for this prompt action they would have lost their lives. Happily both of them recovered. It was found that gas had escaped from the prepayment meter, where solder had been melted by burning paper. It could not be learned from the women what had happened, but it is surmised that, a penny having been placed in the meter, gas had not come readily, and that, in the belief that the meter was frozen, it had been attempted to thaw it by holding flame to it.

Serious Gas Explosion.—A serious explosion of gas, by which five persons were injured (two very seriously) occurred last Thursday at Lydney Park, the residence of Mr. C. Bathurst, the Unionist candidate for South Wiltshire. Some of the servants were engaged in searching for an escape of gas in the housekeeper's room, when one of them raised the chandelier, which she thought had been drawn down too low. Jets of gas were burning in the room, and an explosion followed—the room being completely wrecked. The fire then passed to the kitchen, where considerable damage was done. One of the servants, named Annie Pearce, was blown into the passage and the upper part of her clothing and hair caught fire. Fears as to her recovery were entertained.

Fatal Gas Poisoning in Belfast.—An inquiry was recently held in Belfast into the circumstances attending the death of Mr. John Leeburn, who was found dead in his office on the morning of the 23rd ult. According to the evidence, the deceased went back to his office after the clerks had left. There was a gas-jet as well as a gas-stove in the room; but though there was a flue it did not carry away the fumes issuing from the stove. When the deceased was found, the gas was burning at the jet and in the stove, and he was lying on the floor quite dead. He was removed to the hospital, where an examination of the body was made; the conclusion arrived at being that death was the result of poisoning by carbon monoxide. The Coroner (Dr. James Graham) said it would be well for the Jury to make the recommendation that in future the Corporation should not supply any gas-stoves without seeing that there was in every case a proper flue or ventilation. The Jury agreed to add this to their verdict, which was that death had been caused by carbon monoxide poisoning, the result of inhaling the fumes arising from a gas-stove. A young woman was also found in the office when Mr. Leeburn was discovered. She was in an unconscious condition, and some hope was entertained of her recovery; but she died last Saturday.

Reductions in Price.—As from the 1st inst., the price of gas at Carmarthen has been reduced from 3s. 9d. to 3s. 3d. per 1000 cubic feet. Other reductions recently announced are 1s. per 1000 cubic feet by the Felton Gas Company, and 3d. per 1000 cubic feet by the Winsford Urban District Council. The Wilmslow and Alderley Edge Gas Company have reduced, as from the 1st inst., the price of gas to consumers throughout their district by 2d. per 1000 cubic feet.

Failure of the Electric Light in Dublin.—About ten o'clock last Tuesday night, many of the leading thoroughfares in Dublin were plunged into partial darkness by the failure of the electric light. Several of the arc lamps in Sackville Street and other principal streets were extinguished; while to add to the general discomfiture, private consumers were deprived of their light about 10.30, and much inconvenience was caused to shopkeepers. Private lighting was, however, restored after ten minutes; but the failure of the public supply continued during the night, and the streets presented a dismal appearance. This is the second failure of the light that has occurred within the past few weeks.

Sudden Death of a Beckton Stoker.—An inquest was recently held at Barking in regard to the death of William Thomas Turner, aged 59, which occurred at the Beckton Gas-Works a few days previously. Deceased was walking outside one of the retort-houses when he suddenly fell to the ground, though there was nothing to trip him up. In the evening a fellow-workman noticed that he was ill, and sent for a medical man. Dr. John Guest said he found the deceased quite unconscious, and in a profuse perspiration. Coma came on, and the man gradually died. There was nothing the matter with his head as the result of the accident; and he (witness) was of opinion that death was due to hemorrhage of the brain. The fall had nothing to do with it. The Jury returned a verdict in accordance with the medical evidence.

Life-Saving Apparatus for Use in Noxious Atmospheres.—In June 1907, the Council of the Royal Society of Arts offered (under the Fothergill Trust) a gold medal, or a prize of £20, for the best portable apparatus or appliance for enabling men to undertake rescue work in places where the air is noxious. In response to this offer, a certain number of answers were received. The Council had hoped to be able to make practical tests of the apparatus submitted; but the facilities which they had expected to obtain for the purpose were unfortunately not immediately available, and consequently the proposed trials had to be postponed. The Council are now informed that facilities for carrying out tests will shortly be available. So long a time has, however, elapsed since the original offer, that some inventors who notified their intention of competing have already made improvements in their apparatus, and applications have also been received from other inventors whom the Council would regret to exclude from the competition. After careful consideration of the circumstances, and having regard to the fact that the right was reserved of extending the time for sending in, the Council have now decided to cancel the original offer and to accept for competition any apparatus which may be submitted not later than the 31st of March next.

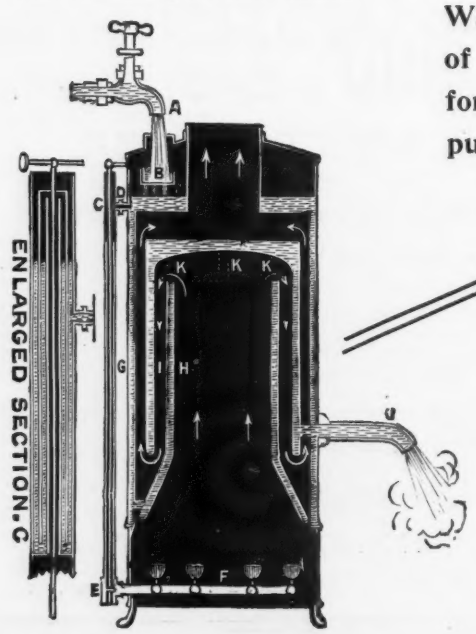
Maughan Geysers

ORIGINAL MAKE . . . . . 40 YEARS' REPUTATION.

Sectional View of "NEW TEBA"

The most perfect made

For description . see Geyser . . . Catalogue No. 7, Page 10. . . .



Water Heaters of all kinds for all . . . purposes. . .

THE PARKINSON STOVE CO., LTD.

(Incorporating MAUGHAN'S PATENT GEYSER CO.)

BIRMINGHAM: Stour Street, Spring Hill.

LONDON: 129, High Holborn.

Suicide of a Gas-Stoker.—A Brighouse gas-stoker, named Charles Bintcliffe, aged 46, who had for some time been out of health, was found sitting in a chair with his head wrapped in a tablecloth. In his mouth was a piece of india-rubber tubing, the other end of which was fastened to a gas-bracket. The services of a doctor were immediately requisitioned; but on his arrival, the man was found to be dead.

St. Ives Water Supply.—An increase in the water rate from 1s. 3d. to 1s. 6d. in the pound was decided upon at the last meeting of the St. Ives (Cornwall) Town Council. Mr. R. S. Read explained that the increase was due to the action of the Local Government Board, who insisted on their carrying out the larger of two schemes for the provision of storage for the water. They had to make a reservoir capable of holding 22 million gallons instead of 14 millions, as at first proposed; and this meant an additional expense of £2000.

Gas Fatality at Watford.—A verdict of "Accidental death" was returned by a Coroner's Jury at Watford, who inquired into a sad occurrence by which the elderly wife of a carpenter named Waterman lost her life. It was stated that the couple had a gas-stove in their bedroom; and on Christmas morning Mrs. Waterman was found suffocated, while her husband, who subsequently recovered, was unconscious. The theory put forward was that a kettle on the stove boiled over, putting out the flames, and that the consequent escape of gas was responsible for the woman's death.

Extensions at Rochdale Gas-Works.—The Gas Committee of the Rochdale Corporation considered at a recent meeting plans for extensions at the gas-works, together with a report of the Engineer (Mr. T. B. Ball) on the matter. The proposals include one for the rebuilding of the old retort-house and the equipment of the new premises with vertical retorts, and the making of a new high-level road and coal-store; the estimated cost of the extensions being £25,000. It was stated that by the new system of carbonization the cost of production would be reduced from 1s. 9d. to about 9d. per 1000 cubic feet. It was resolved that a Sub-Committee should visit London and other places where vertical retorts have been installed.

New Joint-Stock Companies.—Owners of South Pelaw Colliery, Limited, is the title of a Company which has been formed with a capital of £80,000, in £1 shares, to take over the business carried on at the South Pelaw Collieries, Chester-le-Street, and to adopt an agreement with Messrs. T., R. W., & H. D. Foster, T. P. Griffithes, W. T. Dance, J. Hunter, and T. D. Fenwick. The Cove and Kilcreggan Gas Company was registered in Edinburgh last week with a capital of £2000, in 400 shares of £5 each. The public are not invited to subscribe. L. Sterne and Co., Limited (with a capital of £130,000, in £1 shares), has been formed to take over as a going concern the undertaking of Sterne and Co., Limited, and to carry on the business of manufacturers of gas-engines, calorie engines, &c.

Last Thursday, extensive damage was caused by a fire at the residence of Mr. R. C. Swann, Rockcliffe Park, near Darlington. It is stated that electricians were at work installing electric lighting in the mansion; and the supposition is that a wire fused. The fire broke out in the nursery, which was completely destroyed.

On the suggestion of the Town Clerk, the Manager of the Belfast Gas-Works (Mr. R. Sharpe) has been instructed to supply the men employed in cleaning and examining gas cookers and fires on consumers' premises with a uniform, cap, or badge, in order that the consumers may know that these men are appointed by the Gas Department to carry out such work.

At a meeting of the Corporation of Greenock on Tuesday, a letter with reference to a supply of gas for cooking purposes to the new torpedo factory was submitted from Mr. W. O. Pellowe, the Superintending Engineer at Rosyth, in which it was stated that the consumption will probably amount to about 1250 cubic feet per hour for (say) two hours in the middle of the day, and beyond this a considerable amount each day for other purposes. The Gas Manager reported that he was able to fulfil all the requirements.

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situation Vacant.

FOREMAN (Tar Works). No. 5169.

Situations Wanted.

CLERK OR TRAVELLER. No. 5170.
IN LARGE FIRM OR GAS-WORKS (DESIGNING APPARATUS, &c.). No. 5168.
SECRETARY, MANAGER, AND ACCOUNTANT. No. 5115.

Patent Licence.

APPARATUS FOR GASIFYING RAW COMBUSTIBLE MATERIAL. S. F. Paul and Co., Doughty Street, W.C.

Plant (Second-Hand) for Sale.

RETORTS AND FITTINGS, CONDENSERS, SCRUBBERS, PURIFIERS, GASHOLDERS, &c. MacAlister and Skipper, Cambridge.

TENDERS FOR

Condenser, Exhauster, Washers, and Pumps.

SUTTON-IN-ASHFIELD GAS DEPARTMENT. Tenders by Jan. 14.

Fire-Clay Goods.

BURY CORPORATION. Tenders by Jan. 8.
HEBDEN BRIDGE AND MYTHOLMROYD GAS BOARD. Tenders by Jan. 11.
HEYWOOD GAS DEPARTMENT. Tenders by Jan. 18.

General Stores—

(Lead Pipe, Pig Lead, Cast Iron Work)—
PLYMOUTH WATER DEPARTMENT. Tenders by Jan. 20.

Hydrants, Stopcocks, Ferrules, Valves, &c.

PLYMOUTH WATER DEPARTMENT. Tenders by Jan. 20.

Sewerage Works.

YEOVIL CORPORATION. Tenders by Jan. 31.

Tar.

HARWICH GAS AND COKE COMPANY. Tenders by Jan. 10.

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 21.

Issue	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.	Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.	£			p.c.				£ s. d.
590,000	10	Oct. 14	10	Alliance & Dublin 10 p.c.	17–17¼	..	5 14 3	4,940,000	Stk.	Nov. 11	8	Imperial Continental .	175–177	..	4 10 5
298,955	10	,,	7	Do. 7 p.c.	11⅝–12¼	..	5 14 3	1,235,000	Stk.	Aug. 12	3½	Do. 3½ p.c. Deb. Red.	94–96	..	3 12 11
310,000	Stk.	July 14	4	Do. 4 p.c. Deb.	100–102	..	3 18 5	195,242	Stk.	Aug. 26	6	Lea Bridge Ord. 5 p.c. .	119–121	..	4 19 2
200,000	5	Oct. 28	6⅓	Bombay, Ltd.. . . .	5⅝–6	..	5 8 4	561,000	Stk.	,,	10	Liverpool United A. .	223–225	..	4 8 11
40,000	5	,,	6⅔	Do. New, £4 paid .	4⅝–4⅞	..	5 6 8	718,100	,,	,,	7	Do. B . .	166–168	..	4 3 4
50,000	10	Aug. 26	15	Bourne- } 10 p.c. . .	28½–29	+½	5 3 5	306,083	,,	Dec. 29	4	Do. Deb. Stk.	102–104*	..	3 16 11
311,810	10	,,	7	mouth Gas } B 7 p.c. .	16¾–16⅞	..	4 3 7	75,000	5	Nov. 26	6	Malta & Mediterranean.	4⅜–5	..	6 0 0
75,000	10	,,	6	and Water } Pref. 6 p.c.	15¼–15⅜	..	3 16 2	560,000	100	Oct. 1	5	Met. of } 5 p.c. Deb.	59–102	..	4 18 0
380,000	Stk.	Aug. 12	12½	Brentford Consolidated	253–256	..	4 17 8	250,000	100	,,	4½	Melbourne } 4½ p.c. Deb.	100–102	..	4 8 3
300,000	,,	,,	9⅜	Do. New . . .	189–191	..	4 19 6	541,920	20	Nov. 11	3½	Monte Video, Ltd. . .	12¼–13	..	5 7 8
50,000	,,	,,	5	Do. 5 p.c. Pref. .	120–122	..	4 2 0	1,775,892	Stk.	July 29	4⅓	Newc'tle & G'tesh'd Con	106–108	..	4 3 4
206,250	,,	Dec. 29	4	Do. 4 p.c. Deb. .	99–101*	+1	3 19 3	518,795	Stk.	Dec. 29	3½	Do. 3½ p.c. Deb.	91–93*	..	3 15 3
220,000	Stk.	Sep. 10	11	Brighton & Hove Orig.	217–220	..	5 0 0	55,940	10	Aug. 26	7	North Middlesex 7 p.c.	13–13½	..	5 3 8
246,320	,,	,,	8	Do. A Ord. Stk. .	153–156	..	5 2 7	300,000	Stk.	Nov. 26	8	Oriental, Ltd. . . .	137–139	..	5 15 1
467,000	20	Oct. 14	10	British	42½–43½	..	4 11 11	60,000	5	Sep. 10	8	Ottoman, Ltd. . . .	6⅛–6⅜	..	6 5 6
109,000	Stk.	Aug. 26	6	Bromley, A 5 p.c. . .	118–120	..	5 0 0	31,800	53	Aug. 26	13	Portsea Island A. . .	137–139	..	4 19 0
165,700	,,	,,	4½	Do. B 3½ p.c. . .	88–90	..	5 0 0	60,000	50	,,	13	Do. B. . .	129–131	..	4 19 3
82,278	,,	,	5⅛	Do. C 5 p.c. . .	106–108	..	5 1 10	100,000	50	,,	12	Do. C. . .	122–124½	..	4 16 9
55,900	,,	Dec. 29	3½	Do. 3½ p.c. Deb. .	87–89*	..	3 18 8	114,800	50	,,	10	Do. D and E.	101–103	..	4 17 1
500,000	10	Oct. 14	7	Buenos Ayres (New) Ltd.	14–14½	..	4 16 7	398,490	5	Oct. 28	7	Primitiva Ord. . . .	7⅛–7⅜	+⅛	4 14 11
250,000	Stk.	Dec. 29	4	Do. 4 p.c. Deb. .	98–100*	+1	4 0 0	796,980	5	July 29	5	Do. 5 p.c Pref. .	5⅛–5⅜	..	4 13 0
100,000	13	—	—	Cape Town & Dis., Ltd.	3–4	..	—	483,903	100	Dec. 1	4	Do. 4 p.c. Deb. .	97–99	..	4 0 10
100,000	13	—	—	Do. 4½ p.c. Pref. .	5½–5¾	..	—	1,000,000	10	Oct 14	8	River Plate Ord. . .	17–17½	..	4 11 5
50,000	50	Nov. 2	6	Do. 6 p.c. 1st Mort.	48–49	+½	6 2 6	312,650	Stk.	Dec. 29	4	Do. 4 p.c. Deb. .	98–100*	..	4 0 0
100,000	Stk.	Dec. 23	4½	Do. 4½ p.c. Deb. Stk.	80–82*	..	5 9 9	250,000	10	Sep. 29	8	San Paulo, Ltd. . . .	14¾–15	..	5 6 8
157,150	Stk.	Aug. 12	5	Chester 5 p.c. Ord. . .	103½–110½	..	4 10 6	62,500	10	,,	6	Do. 6 p.c. Pref. .	11⅞–12¼	..	4 18 0
1,493,280	Stk.	Aug. 26	5⅞	Commercial 4 p.c. Stk. .	109–111	..	4 13 8	125,000	50	July 1	5	Do. 5 p.c. Deb. .	51–52	..	4 16 2
560,000	,,	,,	5	Do. 3½ p.c. do. .	103–105	..	4 15 3	135,000	Stk.	Sep. 10	10	Sheffield A	233–235	..	4 5 1
475,000	,,	Dec. 29	3	Do. 3 p.c. Deb. Stk.	80–82*	+½	3 13 2	209,984	,,	,,	10	Do. B	233–235	..	4 5 1
800 000	Stk.	Dec. 10	5	Continental Union, Ltd.	95–97	..	5 3 1	523,500	,,	,,	10	Do. C	233–235	..	4 5 1
200,000	,,	,,	7	Do. 7 p.c. Pref.	137–139	..	5 0 9	70,000	10	Oct. 14	10	South African	12½–12¾	..	7 16 11
491,270	Stk.	—	5	Derby Con. Stk. . . .	121–123	..	4 1 4	6,429,895	Stk.	Aug. 12	5½	South Met., 4 p.c. Ord.	120–122	+1	4 7 4
55,900	,,	—	4	Do. Deb. Stk. . . .	103–105	..	3 16 2	1,895,445	,,	July 14	3	Do. 3 p.c. Deb.	82–84	..	3 11 5
143,995	,,	Oct. 2	5	East Hull 5 p.c. Ord. .	97–99	..	5 1 0	209,820	Stk.	Aug. 26	8	South Shields Con. Stk.	160–162	..	4 18 9
486,090	10	July 14	12	European, Ltd. . . .	24⅛–25	..	4 16 0	605,000	Stk.	Aug. 12	5½	S'th Suburb'n Ord. 5 p.c.	120–122	+1	4 10 2
354,060	10	,	12	Do. £7 10s. paid.	18½–19	+¼	4 14 0	60,000	,,	,,	5	Do. 5 p.c. Pref. .	120–122	..	4 2 0
15,141,545	Stk.	Aug. 12	4⅝	Gas } 4 p.c. Ord. . .	103–104	..	4 9 8	117,058	,,	July 14	5	Do. 5 p.c. Deb. Stk.	122–124	..	4 0 8
2,630,000	,,	,,	3⅜	light } 3½ p.c. max. .	87–89	..	3 18 8	502,310	Stk.	Nov. 11	5	Southampton Ord. . .	109–111	..	4 10 1
3,793,735	,,	,,	4	and } 4 p.c. Con. Pref.	103–105	..	3 16 2	120,000	Stk.	Aug. 12	6⅞	Tottenham } A 5 p.c. .	133–135	..	5 1 9
4,193,975	,,	Dec. 29	3	Coke } 3 p.c. Con. Deb.	81–83*	+½	3 12 3	453,940	,,	,,	5⅝	and } B 3½ p.c. .	111–113	..	4 15 3
258,740	Stk.	Sep 10	5	Hastings & St. L. 3½ p.c.	92–94	..	5 6 4	149,470	,,	Dec. 29	4	Edmonton } 4 p.c. Deb.	98–100*	..	4 0 0
82,500	,,	,,	6⅓	Do. do. 5 p.c.	117–119	..	5 9 3	182,380	10	Dec. 29	8	Tuscan, Ltd.	9–9⅛*	+⅛	8 8 6
70,000	10	Sep. 29	11	Hongkong & China, Ltd.	17⅞–18	..	6 2 3	149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	101–102	..	4 18 0
131,000	Stk.	Sep. 10	6⅓	Ilford A and C . . .	144–146	..	4 9 0	236,476	Stk.	Aug. 14	5	Tynemouth, 5 p.c. max.	110–112	..	4 9 3
65,781	,,	,,	5	Do. B	108–110	..	4 10 11	255,636	Stk.	Aug. 26	6⅜	Wands- } B 3½ p.c. . .	139–141	..	4 14 0
65,500	,,	Dec. 29	4	Do. 4 p.c. Deb. . . .	100–102*	..	3 18 5	79,416	,,	Dec. 29	3	worth } 3p.c. Deb. Stk.	72–74*	+½	4 1 1

Prices marked * are "Ex div."

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

Subscribers who desire to avail themselves of the reduction in the Subscription by paying in advance for the Year 1910, are reminded that this can only be done during the present month.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

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O'NEILL'S OXIDE
For GAS PURIFICATION.
LARGEST SALE OF ANY OXIDE.

SPENT OXIDE PURCHASED IN ANY DISTRICT.

GAS PURIFICATION & CHEMICAL CO., LD.,
PALMERSTON HOUSE,
OLD BROAD STREET, LONDON, E.C.

WINKELMANN'S
"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
ANDREW STEPHENSON, 182, Palmerston House, Old Broad Street, London, E.C. "Volcanism, London."

LUX'S GAS PURIFYING MASS.
See Advertisement on p. 1.
FRIEDRICH LUX, LUDWIGSHAFEN-AM-RHEIN.

BROTHERTON & CO., LIMITED.
Offices: City Chambers, LEEDS.
Correspondence invited.

KRAMERS AND AARTS WATER-GAS PLANT.
K. & A. WATER-GAS COMPANY, LTD.
89, VICTORIA STREET, S.W.

GAS TAR wanted.
BROTHERTON AND CO., LTD., Tar Distillers.
Works: BIRMINGHAM, GLASGOW, LEEDS, LIVERPOOL, WAKEFIELD, AND SUNDERLAND.

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WITH AND WITHOUT DIALS.
A. ROUX & CO., Limited,
9, SOUTHAMPTON STREET, HOLBORN, W.C.
MOVEMENTS FOR CLOCKS, PHOTOMETERS AND BAROGRAPHS, WHEELS, PINIONS, AND WORMS.
WORKS, HANDSWORTH, BIRMINGHAM.

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J. W. & C. J. PHILLIPS, 23, COLLEGE HILL, LONDON, E.C., and 25, BRIDGE END, LEEDS.

"NUGEPE" GAS PLANT CEMENT.
JOHN E. WILLIAMS AND CO.,
LOWER MOSS LANE,
MANCHESTER, S.W.
For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

SULPHURIC ACID.

SPECIALLY prepared for Sulphate of AMMONIA Makers by
CHANCE AND HUNT, LIMITED,
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Works: BIRMINGHAM, GLASGOW, LEEDS, LIVERPOOL, WAKEFIELD, AND SUNDERLAND.

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APPLICANTS for the Post advertised in the "Journal" on Dec. 14 (No. 5163), are informed hereby that the VACANCY HAS NOW BEEN FILLED. Will they kindly accept this Acknowledgment of the Particulars Furnished?

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BOROUGH OF HEYWOOD.

THE Gas Committee of the Corporation of Heywood are prepared to receive TENDERS for the Supply of RETORTS and FIRE-CLAY GOODS.
Specification and Quantities and Form of Tender may be obtained upon Application to Mr. W. Whatmough, Gas Manager.
Sealed Tenders, endorsed "Retorts and Fire-Clay Goods," to be sent to me not later than Tuesday, Jan. 18, 1910.
By order,
Geo. G. Bouchier,
Town Clerk.
Municipal Buildings,
Heywood, Jan. 1, 1910.

TO RETORT AND FIRE-BRICK MANUFACTURERS.

THE Corporation of Bury are prepared to receive TENDERS for RETORTS, FIRE-BRICKS, and FIRE-CLAY required at their Gas-Works.
Forms of Tender may be obtained from Mr. H. Simmonds, Engineer and Manager, Gas-Works, Bury.
Sealed Tenders to be sent to the Town Clerk, Bury, not later than Saturday, Jan. 8, 1910.

HARWICH GAS AND COKE COMPANY.

TENDERS are invited for the Surplus TAR produced at this Company's Works for the Year ending Dec. 31, 1910.
The Tar will be delivered Free into Railway Tank-Waggons or Tank-Barges at this Works.
Probable Quantity, 120 Tons.
The Directors do not bind themselves to accept the highest or any Tender.
Sealed Tenders to be delivered addressed to me not later than the 10th day of January, 1910.
Geo. Baines,
Secretary.

HEBDEN BRIDGE AND MYTHOLMROYD GAS BOARD.

THE above Gas Board are prepared to receive TENDERS for the Supply of RETORTS, FIRE-BRICKS, &c., required by them for Twelve Months ending Dec. 31, 1910.
Further Particulars from E. J. Wellens, Engineer and Manager, Gas Offices, Hebden Bridge.
Sealed Tenders, endorsed "Fire-Clay Goods," addressed to James Simpson, Esq., Chairman of the Gas Board, Gas Offices, Carlton Street, Hebden Bridge, and delivered at these Offices not later than Tuesday, the 11th of January, 1910.
R. Crabtree,
Clerk to the Gas Board.
Gas Offices, Carlton Street,
Hebden Bridge, Dec. 28, 1909.

PLYMOUTH CORPORATION WATER-WORKS.

TENDERS are invited for the Supply of the following GOODS and MATERIALS for the period of One Year:—
Fire-Hydrants.
Lead Pipe and Pig Lead.
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Cast-Iron Work.
Sluice-Valves.
Particulars and Forms of Tender can be obtained at this Office on and after Jan. 1, 1910.
The lowest or any Tender will not necessarily be accepted.
Tenders, enclosed in Envelopes provided, to be delivered at this Office by Twelve o'clock Noon on Thursday, Jan. 20, 1910.
Frank Howarth, M.Inst.C.E.,
Water Engineer.
Municipal Buildings, Plymouth.

SUTTON-IN-ASHFIELD URBAN DISTRICT COUNCIL.

GAS-WORKS EXTENSION.

PERSONS desirous of Tendering for the Supply and Erection of a CONDENSER, EXHAUSTER, LIVESEY WASHER, ROTARY WASHER and PUMPS, in connection with the above, are requested to send their names and addresses to Messrs. Corbet Woodall and Son, Palace Chambers, Bridge Street, Westminster, S.W., not later than Friday, the 14th day of January, 1910, together with Deposit Cheque of £1 1s. for Copies of Specifications, Drawings, and Form of Tender.
The Deposit will be returned on receipt of a *bond-fide* Tender.
The lowest or any Tender will not necessarily be accepted.
John D. Fidler,
Clerk to the Council.
Council Office,
Sutton-in-Ashfield.

YEOVIL CORPORATION.

SEWERAGE WORKS.

THE Corporation of the Borough of Yeovil are prepared to receive TENDERS for the Construction of certain SEWERS, DRAINS, and OTHER WORKS within the Borough and in the Parish of Yeovil Without.
Drawings may be inspected, and Specifications and Forms of Tender, with Schedules of Quantities, can be obtained, on Payment of the sum of Two Guineas (to be returned on receipt of a *bond-fide* Tender) on Application at the Office of the Borough Surveyor at Yeovil or at the Office of Messrs. T. and C. Hawksley, Civil Engineers, Caxton House, Westminster, S.W., on and after Monday, the 10th day of January 1910; and Tenders, marked "Sewerage," to be addressed to the Town Clerk, must be delivered at his Office in Yeovil at or before Noon on Monday, the 31st day of January, 1910.
The Corporation do not bind themselves to accept the lowest or any Tender.
Henry B. Batten,
Town Clerk.
Yeovil, Dec. 30, 1909.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MESSRS. A. & W. RICHARDS beg to notify that their SALES BY AUCTION of NEW CAPITAL ISSUED UNDER PARLIAMENTARY POWERS, and of STOCKS and SHARES belonging to EXECUTORS and other PRIVATE OWNERS in LONDON, SUBURBAN, and PROVINCIAL GAS and WATER COMPANIES, take place PERIODICALLY at the Mart, TOKENHOUSE YARD, E.C.
Terms for Issuing New Capital, and also for including other Gas and Water Stocks and Shares in these Periodical Sales, will be forwarded on Application to Messrs. A. & W. Richards, at 18, Finsbury Circus, E.C.

THE Proprietor of the Patent No. 2245, of 1906, relating to "AN IMPROVED METHOD OF, AND APPARATUS FOR GASIFYING RAW COMBUSTIBLE MATERIALS," is desirous of entering into Arrangements, by way of LICENSE and otherwise, on Reasonable Terms, for the purpose of EXPLOITING the same and ensuring its full Development and Practical Working in this Country.
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Makers of Cast-Iron PIPES and CONNECTIONS for Gas, Water, Steam, Electrical, Sanitary, and other purposes; also TANKS, COLUMNS of every description, Hydraulic, Gas, and Colliery PLANT, &c.
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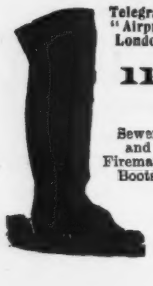

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Impervious to Main Liquor and Climatic Influences.
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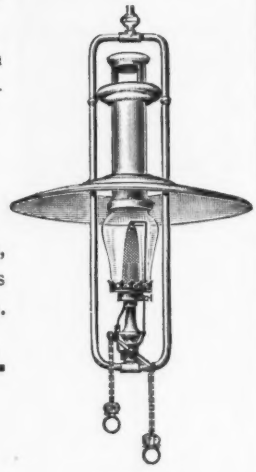

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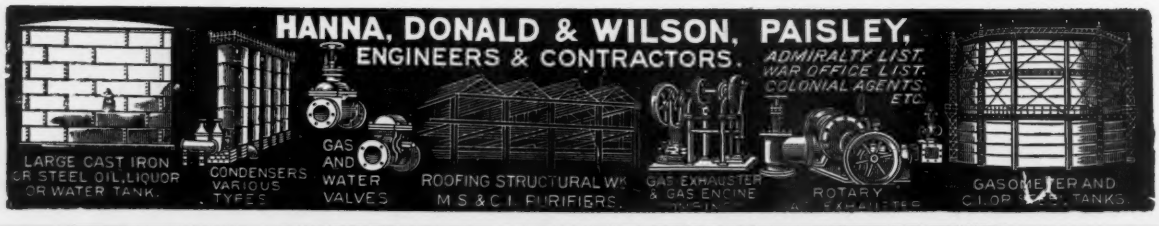

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A. The Authors used *Flanged Pipes* for the Rising Main up the Steep side of the Barff, and their experience proved that this was not an advantage, as *the rigidity of the Joints involved considerable difficulty* in regard to the depth of the Trench, and a good deal of Cutting to make the final Connections at each end of the Pipe-Line.

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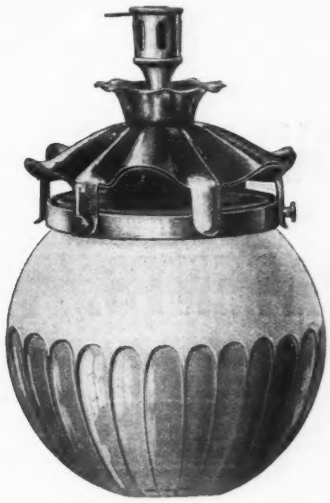

No. 3 "DARWIN." 3½in. Fitting.

Have been remodelled, and we now offer you

BETTER BURNERS

AT

REDUCED PRICES

And guarantee the highest finish and Workmanship.

Independent Test by a well-known Gas Manager of No. 3 Burner.

CONSUMPTION . . . 3·55 ft.
of Gas at 15/10ths Pressure,

CANDLE POWER . . . 122·76

These figures speak for themselves.

Breakage of Mantles and

MAINTENANCE CHARGES

Reduced to a minimum.

Made in 3 SIZES and 8 PATTERNS

BY

CHARLES JOYNER & CO., LIMITED,

Icknield Square,

BIRMINGHAM.

CONTINUOUS CARBONIZATION

IN

VERTICAL RETORTS

* *

GLOVER-WEST PATENTS.

Description and Particulars of Tests will be forwarded on request.

* *

COST OF LABOUR

REDUCED TO

$2\frac{3}{4}$d. PER TON OF COAL CARBONIZED.

See "JOURNAL OF GAS LIGHTING," Nov. 2, 1909.

WEST'S GAS IMPROVEMENT CO., LTD.,

Engineers,

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Telegrams—"STOKER, MANCHESTER."
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Telephones—Nos. 1339 and 5520 Manchester (Central).
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MILES PLATTING, MANCHESTER.

Welsbach LIGHT

Inverted Arc Lamp, Fig. 623.

Storm Proof—

For Exterior Lighting.

Welsbach-Kern

(Patent) Inverted System

BRITISH MADE. **BRITISH MADE.**

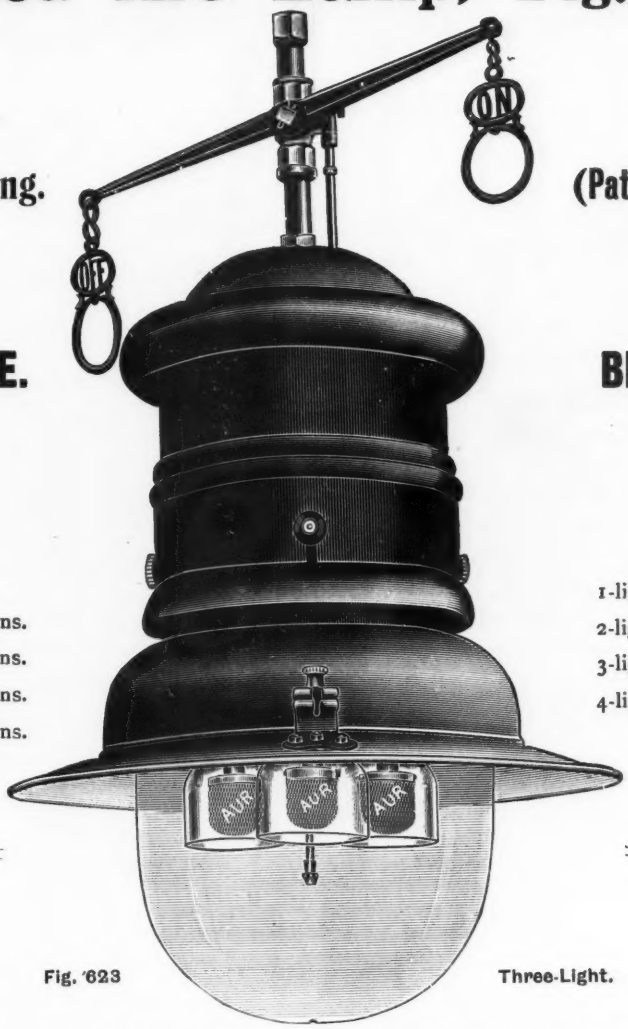

Fig. 623 Three-Light.

Height over all.

1-light . . .	1 ft. 8 ins.
2-light . . .	2 ft. 4 ins.
3-light . . .	2 ft. 4 ins.
4-light . . .	2 ft. 7 ins.

Width over all.

1-light . . .	1 ft. 1 in.
2-light . . .	1 ft. 5 ins.
3-light . . .	1 ft. 5 ins.
4-light . . .	1 ft. 8 ins.

ENAMELLED Green Steel Casing, fitted with Welsbach-Kern Inverted Burners, Gas and Air Regulators operated from outside. Sliding Door to give access to Burners for cleaning purposes. Fitted with Magnesia Nozzles, Welsbach Mantles, and Glass Mantle Protectors. Complete as shown. Highly efficient and regenerative.

	Gas per hour.	*C.P.*	*Steel.*	*Copper Case.*
1-light	4 feet	125	**30/-**	**5/-** extra.
2-light	8 feet	260	**47/6**	**6/-** extra.
3-light	12 feet	400	**52/6**	**6/-** extra.
4-light	16 feet	550	**72/6**	**9/-** extra.

All on or off, or One light on and the rest off, **7/6** per Lamp extra. Cup and Ball, **3/6** per Lamp extra.

RENEWALS.

Glass Mantle Protectors (Fig. 623) **3/4½** per dozen, or in case lots of 5 gross, **33/-** per gross.

	1-Light.	*2-Light.*	*3-Light.*	*4-Light.*
Clear Glass Globes, each	**2/3**	**5/9**	**5/9**	**9/-**
" " " In Case lots per dozen.	**19/6**	**57/9**	**57/9**	**93/-**
Case contains . .	*80*	*18*	*18*	*12*

	1-Light.	*2-Light.*	*3-Light.*	*4-Light.*
Wired Globes, extra each	**2/-**	**2/-**	**2/9**	**3/6**
Parabolic Reflector, extra "	**3/6**	**6/-**	**7/6**	Not made

Welsbach Mantles, each **6d.** subject as usual.

The Welsbach Mantles for Upright lighting are "C," "CX," and "Plaissetty," price **4½d.** each.

THE WELSBACH INCANDESCENT GAS LIGHT CO., LTD.,

Welsbach House, 344-354, Gray's Inn Road, London, W.C.

Telegrams and Cables: "WELSBACH LONDON." *Telephone 2410 NORTH.*

SILICA MACHINE MADE RETORTS.

TRADE "C.O." MARK. REGISTERED.

THE NEW RETORT

Will withstand high temperatures and is **Guaranteed not to Contract or Soften** under Heat.

GREATER CONDUCTIVITY THAN ANY FIRE-CLAY RETORT.

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WILL DISCHARGE A RETORT IN ONE OPERATION

LARGE NUMBERS IN USE.

Full Particulars may be obtained from the Sole Makers,

SIR WILLIAM ARROL & CO., Limited,

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[See Illustrated Advertisement, Dec. 21, p. 844.]

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No Steam.

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No Power.

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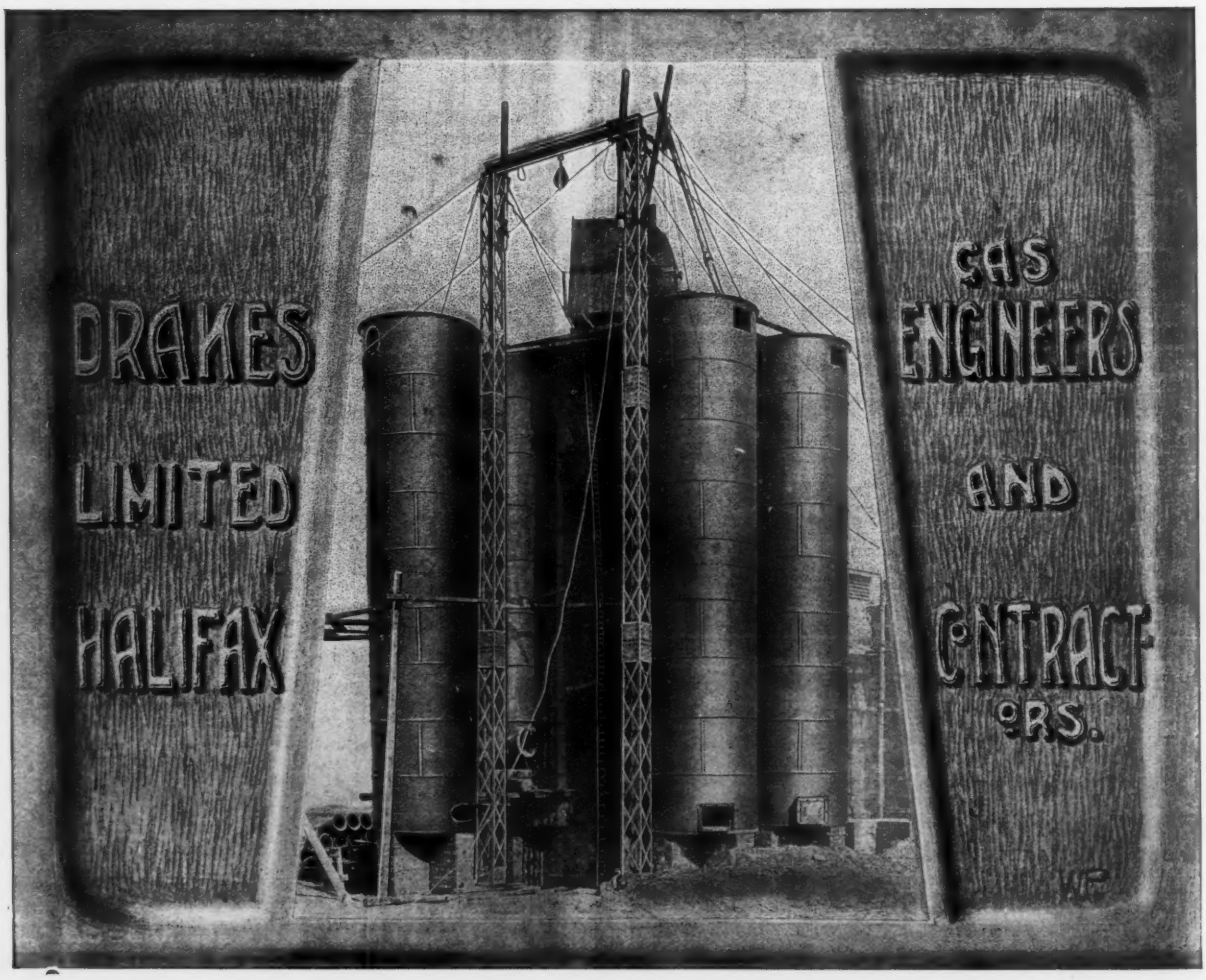

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FOR

MANUFACTURED FROM OUR CAREFULLY SELECTED AND WELL SEASONED STOCK OF OLD MINE FIRE CLAY.

RETORTS

MECHANICAL COAL HANDLING PLANTS

OF ANY MAGNITUDE

MADE AND ERECTED BY

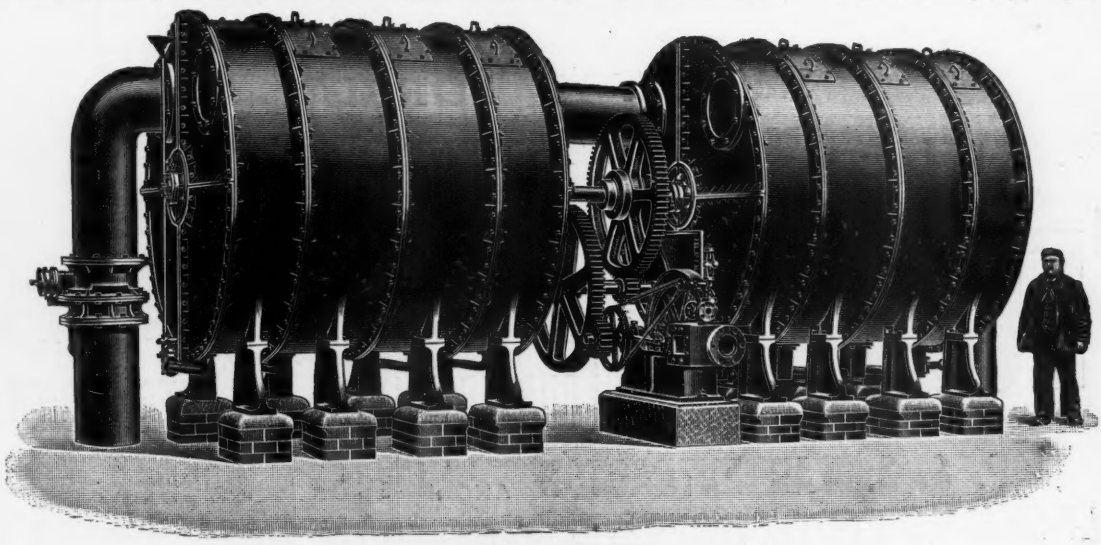
GIBBONS BROTHERS LTD

DUDLEY & LONDON

ROTARY WASHER SCRUBBER.

Capacity 2,500,000 cubic feet per day,

For Gas-Works, KINGSTON-ON-THAMES. H. W. Packham, Esq., Engineer.



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HIGH PRESSURE GAS.

Rotary Compressor driven by Electric Motor.

Made in various sizes for High-Pressure Lighting, or Boosting District Mains, &c., and arranged for any Pressure up to 5 lbs. per square inch.

Also made for driving by Steam, Belt, or direct coupled Gas-Engine.

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CLAPHAM BROTHERS

ESTABLISHED 1837.

LIMITED.

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OUR SPECIALITIES ARE IN GREAT FAVOUR.

"ECLIPSE"

BALL WASHER SCRUBBER (Laycock and Clapham's Patent).

WATER TUBE CONDENSER (Clapham's Patent).

RAPID AUTOMATIC FASTENINGS

15,000 Sold, and

RUBBER JOINT FOR DRY-LUTE PURIFIERS

30,550 Feet Sold.

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Printed and Published by WALTER KING, at No. 11, BOLT COURT, FLEET STREET, in the CITY OF LONDON.—Tuesday, Jan. 4, 1910.